THE REFINER AND NATURAL GASOLINE MANUFACTURER

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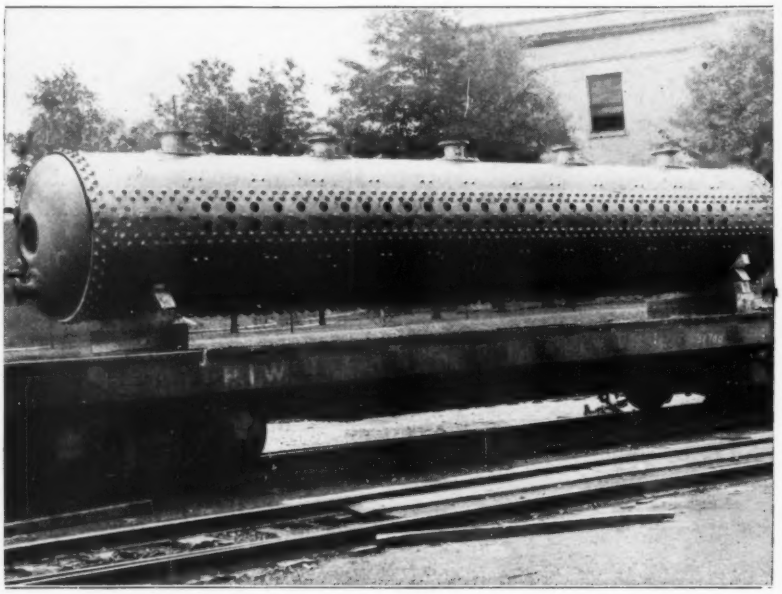

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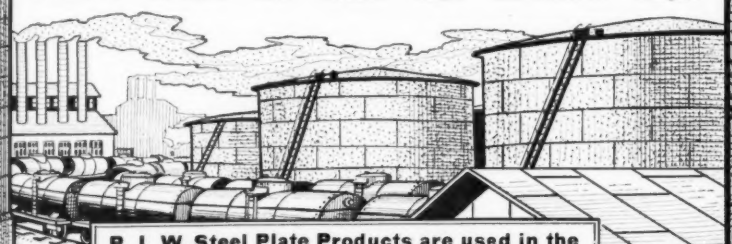

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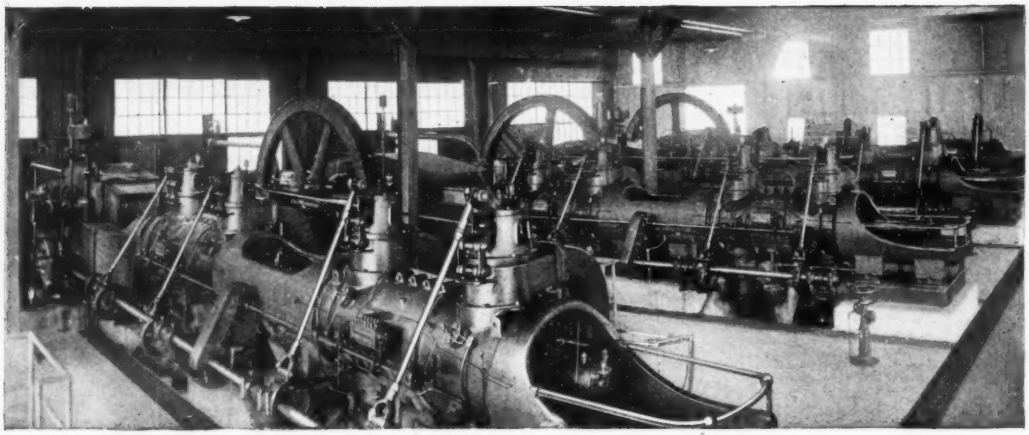

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Excess California Crude Bids for Refineries

Present production in state exceeds capacity of plants by more than 130,000 barrels a day

Los Angeles, Cal., Nov. 24.— The daily refining capacity of California is slightly over 300,000 barrels. The daily production of crude last month was 432,000 barrels, with something like 75,000 barrels a day shut in. Not all of this oil is refinable, but the bulk of the oil being taken from the ground at this time is refinable, so that there is a real surplus of production of refinable oil over the refining capacity of the state.

If all the refineries are built which are now being projected, or about which rumors are being circulated, the refining capacity of the West Coast will be as much overbuilt as it was in Texas during the boom days of the new fields of that state. That some of those rumored will actually be built is now beyond question.

It is generally conceded that the Shell Company will build a refinery in southern California. While no official announcement has been made to that effect, plans are already under execution, for preliminary physical equipment and construction at a site near Wilmington, adjacent to Los Angeles harbor. The fact that no official announcement has been available regarding the project is explained by the difficulty of obtaining any details regarding what the Shell organization plans to do, as a general policy.

The Shell outfit is erecting retail sales stations for its refined products throughout southern California. It promises to mix things with Standard throughout the whole of the West Coast trade territory.

The action of the Shell in providing its own refinery capacity in southern California is taken to mean that no further effort will be made to get a control interest in the Union Oil Company of California. The recent visit of Sir Henry Deterding to Los Angeles, and the counter visit of W. L. Stewart, president of the Union of California to London, are both unexplained, and rumor mongers find it easy to conjure up theories about negotiations between the Shell and the Union having been climaxed and finally terminated. There has been a lot of high sounding charges made against the Shell, and a lot of pussyfooting by high officials of both organizations, but when the smoke is all cleared, it is believed that the general situation will be simply this: Shell owns and will maintain about 27 per cent of the Union of California stock; Union of California through the Holding Company recently formed, will be able to perpetuate the present management of the organization; Shell, being unable to get control of an organization already having refining and marketing facilities, will provide these by building from the ground up. And the history of the Dutch outfit is that it is able to make things lively for those who propose to curb its operations, or drive it from any coveted goal.

So it is generally held that the Shell will add to the refining capacity of the West Coast by one of the largest and completest plants of the country. It has already secured an advantageous location for such a plant, and preliminary work is reported to have been started.

Other Rumors

A report published this week indicates that several other organizations contemplate following the lead of the Shell and building new refining plants. That the report is greatly overdrawn is apparent. That there is a grain of truth in it is also apparent.

General Petroleum Company has a big topping plant in Vernon, and is so crowded for room at this location that it is believed likely that the company would not make any great expenditure for enlargements here. It is also pointed out that Vernon is not the logical place for a complete refining plant, but that such a plant can be most economically operated from a point near tidewater. General Petroleum has, during the past year, built up a tremendous production of refinable oil. It is reported that a handsome stock dividend has been agreed upon and will be handed out to stockholders of this corporation shortly. The stock units will also be reduced from $100 to $25. All this is preparatory to some expansion in the manufacturing end, according to reports.

If the General Petroleum Corporation expects to refine its own production, it will build a refinery. If it builds a refinery, it is considered likely that it will build near tidewater. And such an effort would naturally be in keeping with the way this company is doing business in California, and would therefore be one of the so-called big plants, when completed. Recent reports are that chemists in the employ of this company have worked out a plan for the manufacture of lubricating oils from asphalt base crude, that corresponds in all essential characteristics to lubes made from paraffine base crudes. This report, whether true or not, or no matter what it means scientifically, tends to the

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Decolorization by Absorption of Filtration

Temperature of filtration, size of grain and material selected of great importance

By F. N. Williams

Decolorization of oils by filtration is effected by permitting the oil to be decolorized to percolate through the selected discolorizing material, of which there are many, namely Fuller's earth, bone charcoal, bauxite, ignited peat, bog iron ore, china clay, etc., which separates and retains the dissolved solid and colloidal impurities, coke, floc, moisture and finely divided carbon.

The filters are vertical cylinders, generally of small diameter, although the dimensions vary with the class of oil dealt with, and with the color desired, both as to height and diameter.

The temperature of filtration and size of grain is of great importance as well as the kind of filtering material selected. The relative decolorizing efficiency of various materials may be noted in the chart.

That the temperature at which the absorbing material exerts its specific effect is important, is shown by Gilpin & Schnerberger, who found that on passing California crude through Fuller's Earth at 20° C found little fractionating effect, but showed satisfactory results at 70° C. The same may be said of cold bauxite which was found to have lost its power of absorbing sulphur derivatives from kerosene, but, when freshly heated to 200° C its activity in that direction was regained. Heat appears to be evolved during active absorption, thus a 20° C rise in temperature was observed during the passage of 100 c.c. of kerosene through 50 grains of bauxite.

The combined sulphur content of illuminating oils is materially reduced by filtration through Fuller's Earth, thus, kerosene from Mexican crude indicated a reduction of sulphur content of from .750% to 620%, kerosene from Kentucky crude from .34% to .270%, again in this case the temperature of the adsorbing agent is of importance.

Silica-Gel, however, appears to have the property of adsorbing sulphur compounds with greater thoroughness than any of the mentioned agents, the surphur content of kerosene has been reduced to an almost inestimable quantity by filtration through, or digestion with, this material.

The following chart indicates the properties of gasoline, ad-

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theory that the company is working out a program for the manufacture of a complete line of petroleum products. This factor contributes some light on the theory that it will build a big refinery, in addition to the topping plant it now operates.

Associated Oil Company is another organization which is so connected and so organized that it could profit greatly from a refining plant in the vicinity of Los Angeles harbor. Through the Amalgamated Oil Company, Associated has come into possession of a nice production of refinable crude from the new fields of the southern part of the state, and to ship this crude to San Francisco bay for refining, then shipping the refined products back to southern California for marketing, is an expensive operation. The company is extending its sale facilities in the southern part of the state, and all signs indicate that it expects to add to its manufacturing facilities in the south.

The Amalgamated operates a topping plant in Los Angeles, producing distillates or tops, and fuel oil, the latter product going to the Pacific Railroad for fuel. The Pacific Railroad Company formerly owned the whole Pacific Oil Group, including Associated Oil, Amalgamated Oil, etc. By the recent divorcement, Pacific Oil is independent, though the stock is held largely by stockholders of the Southern Pacific Company.

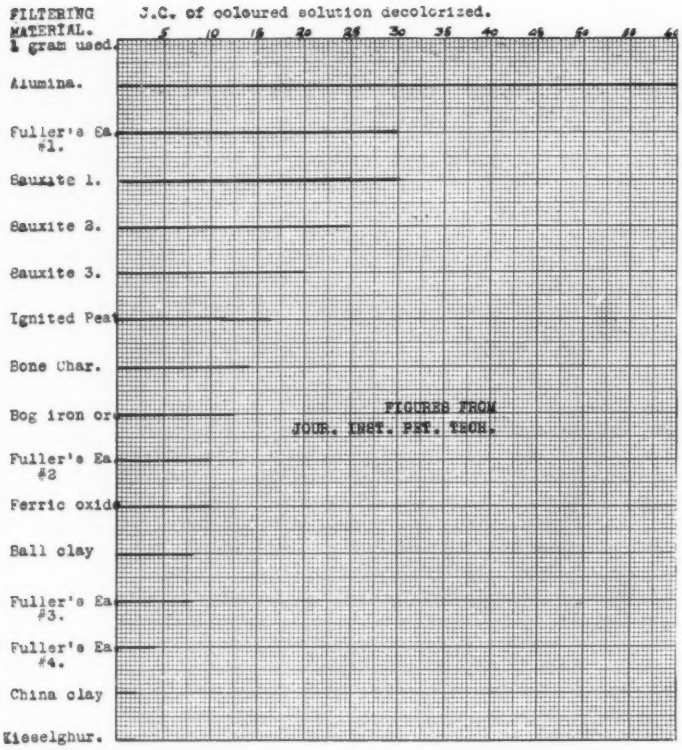
One report recently tended to the theory that Associated would revamp the Amalgamated's topping plant in Los Angeles, equipping it to manufacture a full line of petroleum products. Later reports indicate that instead of this policy, the Associated will build a refinery, from the ground up, on recently acquired acreage near Los Angeles harbor. It has been definitely announced that the company will greatly increase its shipping facilities at this harbor.

The report referred to above, also stated that Union Oil Company and Standard Oil Company would build entirely new plants in the vicinity of Wilmington. The fallacy of such a theory is readily apparent, in the fact that both Union and Standard already have enormous plants, with plenty of room for expansion, within a few miles of Los Angeles harbor.

A whole bevy of small plants are being erected, or are to be erected in territory adjacent to the new fields near Los Angeles. Reports that Pan American Petroleum Company would enter the refining game on the West Coast are now generally discredited. But smaller organizations, and especially new companies which are being proposed or actively organizing, seem to indicate that a half dozen or more small topping plants will be running in addition to those already in operation, before the end of the coming year.

From the standpoint of a market for all the output of these additional plants, the situation is not so rosy. The crude to process is readily available. But the market for gasoline, kerosene, and fuel oil is very well taken care of already, by the refineries which have been in operation over the past years. Unless a greatly increased foreign demand justifies the rapid enlargement of the refining capacity of this territory, the situation bids fair to become complicated. The larger companies are in position to go out and develop markets, to enter territory not heretofore considered available, on a competitive basis with dealers from other parts of the country, and so force a market for their output. But while they do that, they are not going to overlook the home territory. And the smaller company, with less economic management because on a smaller scale, may find itself facing four ways to trouble.

Regardless of who builds or who does not build refineries in southern California, it is agreed that the excess production of crude oil in the new fields here afford an opportunity which refiners will not pass up. And manufacturers of refining equipment and supplies will find this territory their best bet during the coming months.



sorbed by silica-gel as gas, from the still gasses from Mexican crude, which gas is of high sulphur content.

Gravity..70.3 Be.
Sulphur.. .034%
Dr..... O. K.
Color.... 25
I. B. P... 108°F.
58% @ 212°F.
96% @ 302°F.
D. P. 335°F.

Distillation, Tagliabue Apparatus

Method: The still gas was passed through the silica-gel until same was saturated to capacity (which, in this case, was the entire distillation of one barrel of Mexican crude) the saturated silica-gel was then heated driving the adsorbed gas through a suitable condenser of the coil type, until all condensable material was driven off. It will be noticed that practically all of the sulphur compounds were retained by the gel, (as is indicated by the negative doctor test and the low sulphur content of the condensed material), and then driven off during activation of the gel for further use.

Temperature of Filter

Filters for filtering cylinder stocks, wax are kept at 150° F, heavy viscous engine oils, 120 to 130° F. Non-viscous oils at 90° F., kerosene at ordinary temperature as in most cases it is only desired to remove the floc from kerosene.

Filtration is carried on through the same material until the filtered material issuing from the filter is of poor or non-marketable color, when the filter feed is stopped and the filter permitted to drain and when satisfactorily drained, a wash of warm naphtha is introduced, then drawn off, and this procedure continued until the effluent is colorless or nearly so. Steam is then introduced and the filter and contents thoroughly steamed to remove the naphtha. The bottom of the filter is then opened and the Fuller's Earth or other material is removed and is ready for revivification, which is accomplished in suitable apparatus at about 1000 to 1200°F.

Notes

Oils to be filtered efficiently should be thoroughly dry (free of moisture) as the Fuller's Earth will readily take up same, which renders it unfit for proper filtration.

Fuller's Earth should be properly ignited before use to drive out or remove all of its hygroscopic moisture and most of its water of crystallization. The color of the ignited earth to the experienced eye is a sure guide to proper drying.

Chemicals

Parsons[1] states that the water of composition is not an essential factor in the bleaching power of all Fuller's Earth and that some decolorize equally well before and after the removal of the water, while others lose a larger part of their bleaching effect when their water is evaporated.

Whether the bleaching action is chemical or physical is a matter of conjecture. Lob[2] appears to consider the bleaching to be due to the presence of some substance in the earth that enters into combustion with the coloring matter of the oil, forming an insoluble compound, and on the other hand Grafe[3] considers decolorization a physical and not a chemical process.

That the operation is selective is evidenced by the fact that some filtering materials will first retain sulphur compounds followed by the aromatics in regular order, at the same time permitting the passage of the parafines.

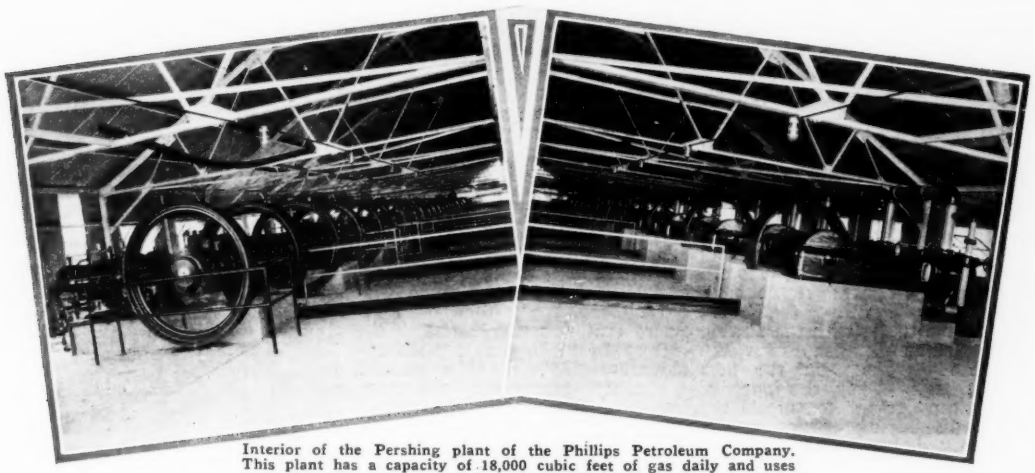
[1]Bureau of Mines, Bulletin 71.
[2]XX Chem. Rev. 1908 (15).
[3]I Petroleum 1907 (3).

Refinery to Be Built By California Concern

Los Angeles, Dec. 1.—The Blue Tank Pipe Line and Refining Company is being formed, headed by Vern Duman, a successful operator at Long Beach, for the purpose of building a refinery near Wilmington, according to reports this week. The new company will include some independent producers at Long Beach, and its is reported that a plan has been worked out for the sale of the refined oils through an exporting company.

Kansas City, Mo.—The Miller Petroleum Company, operating refineries at Humboldt, Kansas, and Wichita Falls, Texas, has declared an initial dividend of $1 a share on the 55,000 shares outstanding.

The company also is engaged in expansion work on its gathering line and storage in the Virgil pool in Kansas.



Interior of the Pershing plant of the Phillips Petroleum Company. This plant has a capacity of 18,000 cubic feet of gas daily and uses the absorption method

Absorption Process Gains Favor in Oklahoma

Method now being used by majority of new plants—Idea formerly received skeptically

By Grady Triplett

In the development of the natural gasoline industry in the Mid-Continent fields in the past three years, no change has been more significant than the turn from the compression to the absorption method of manufacture.

From their investigation, published in 1919 as "Absorption as Applied to Recovery of Gasoline Left in Residual Gas from Compress Plants," W. P. Dykema and Roy O. Neal of the Bureau of Mines, had this to say, " the Oklahoma Corporation Commission has listed in its files more than 230 active gasoline plants; 90 per cent of these use the compression method, which, as this study proves, is not altogether satisfactory as regards efficient recovery."

Today that proportion is reversed. Fully 90 per cent of the natural gasoline plants being built in Oklahoma, and that goes for North Texas and Kansas, are absorption plants. The Tidal Gasoline company is converting all its compression plants to the absorption process.

Reasons For Change.

Of the reasons for the turn to the absorption process for recovery of gasoline from casinghead gas, the efficiency of the latter method over the former when using gas that yields less than two gallons from each 1,000 cubic feet of gas is perhaps foremost.

Familiarity with the absorption process is another factor in the change.

Lower cost of the plant building is another point in favor of the absorption plant.

That the compression process had limitations was one of the conclusions of Messrs. Dykema and Neal in their investigations from which Technical paper No. 232, above mentioned, was written. Quoting on this point this paper reads, "It is impossible to recover all of the gasoline in casinghead gas by means of compression, unless excessive pressures or extremely low pressures are maintained. Even with rich gas the efficiency of recovery necessarily decreases as the gas gets leaner and the resulting partial pressures of the condensable vapors increase. It has been stated that the compression system will remove all of the gasoline from wet casinghead gas, certainly from gases containing from two gallons more per 1,000 cubic feet." The writers have tested the residual gas from compression plants operating at 72 degrees F. (temperature of gas in accumlators) on 10-gallon gas and have found the plants losing as much as 340 gallons per 1,000,000 cubic feet, which could undoubtedly be recovered at a profit by absortion."

Investigations conducted by the writers quoted above was to determine the efficiency of installing small absorption towers in connection with compression plants. In their work they conducted experiments at 27 Oklahoma natural gasoline plants. These were in the Bartlesville, the Nowata, the Sapulpa, the Okmulgee and the Cushing districts. The plants had capacities from 500,000 to 3,500,000 cubic feet of gas daily and operated on gas that yielded from 1.2 gallons to 10 gallons from 1,000 cubic feet of gas.

The average loss of gasoline from these plants was .337 gallons from each 1,000 cubic feet of gas. The lowest loss was .13 gallons per 1,000 cubic feet of gas and the highest was .808 gallons from 1,000 cubic feet of gas.

These averages were the result from treating the residual gas of compression plants by absorption methods. In turn the residual gas after the absorption process had been used was tested. In no case had the recovery been less than 80 per cent. In the plants tested in the Bartlesville district, the recovery by absorption was 97 per cent.

Should the writers of the paper quoted herein conduct another investigation in Oklahoma they would have no occasion to come to a conclusion shown in the following statement of their paper, "Some of the most efficient gasoline plants in the Mid-Continent field use the absorption process. The engineers in charge deserve much credit, as plant owners were

Independent Refiners Don Fighting Togs

Meeting at Kansas City starts action to cope with garvity basis for buying crude

Kansas City, Mo.—The independent refiners of the Mid-Continent, at least some 80 of them present or represented at the recent meeting of executives and sales managers of the Western Petroleum Refiners Association, have their "fighting togs" on, ready for a tussle with the Prairie Oil and Gas Company over the purchase of crude on the new gravity basis. They, the independents, are going to meet the Standard's buying agency on its own ground, too. They have accepted the gravity basis for buying crude oil; they will not pay premiums hereafter, at least not more than ten cents a barrel, nor will they bid against each other for crude even to the ten cent limit. More than that, asking the Mid-Continent Oil and Gas Association to co-operate with them, the independent refiners are going to the independent producer, through an educational campaign, to show the man who takes the crude oil from the ground it is to his advantage to sell to the independent refiner rather than to favor the Prairie.

All of that is definite program adopted at the meeting President George Moore, of the Western Association, called for Kansas City November 22, a gathering of refiners that was the largest in the history of the association, so the oldtimers said after adjournment.

Mr. Moore in calling the meeting to consider the Prairie's action in putting the purchase of crude on the gravity basis, declared it "the most important subject" with which the independent refiner has been confronted in "the past several years." Other refiners evidently agreed with Mr. Moore, judging from the noteworthy attendance and great interest taken in the proceedings of the gathering.

After a day of discussion, many speeches and considerable argument, the refiners agreed to these outstanding planks: They will meet the gravity schedule, as announced by the Prairie; they would oppose premimums in excess of ten cents a barrel, not even that much unless absolutely required to get the amount of crude needed. They will not bid against each for crude. They will standardize the instruments for taking gravities, using the same instruments and methods as the Prairie, if possible. They will conduct an educational campaign, as suggested before, showing that the independent refiner, now taking 300,000 or more barrels of oil daily is the best customer the independent producer can have, else Mid-Continent crude would be as low as Wyoming oil—where the independent refiner is not. Another fact along that line was pointed out, if the independent producers should turn all their crude to the Prairie, the latter could not handle it all, for to care for it as it is now, with the independents taking such a big bulk, would require four or five years for the construction of additional Prairie pipe lines.

The refiners agreed that contracts based upon the old posted price of crude are voided by the Prairie's action, because there is no one posted price, but seven prices now. It seemed the general idea that 35 gravity is about the average of Mid-Continent crude, everything considered, and the proper basis for computing fuel contracts at this time would be $1.52½. It was held a basis must be established by accurate computation so there will be no trouble in figuring fuel oil prices.

There was much discussion as to whether it would be necessary to pay premiums. One refiner said the independent could buy of the independent producer on his "personality." E. R. Perry, of Cosden and Company, replying said it was true the independents have "personality." "But," said he, "the big company has purse-inality." That, of course brought a big hearty laugh, and the windup was the limit for premium was fixed at ten cents a barrel. The importance of accurate instruments was stressed, it being shown that in the use of hydrometers a variation of one-tenth of a degree means a difference of 20 cents a barrel in the price obtained for the crude under that particular test. There are now two standard instruments, with a dif-

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skeptical of the success of absorption in replacing compression."

Prejudice is Passing

A check of the plants in North Texas is ample evidence that prejudice against the absorption type of natural gasoline plant is passing. In Wichita County there are 33 natural gasoline plants, only two of which are of the absorption type. Most of the Wichita County plants were built following the Burkburnett strike and at a time when compression held a lead over the other type.

In Stephens County, where construction of natural gasoline plants is more recent, the situation is reversed. Stephens County has 21 plants, 20 using the absorption process and one a combination plant.

Economy of construction of absorption plants in comparison with the compression type is a matter as much of design and specifications as it is of difference between the two types. Gasoline manufactures are agreed that an absorption plant can be more cheaply built than a compression plant, except in instances were a one unit plant is concerned. For extremely rich gas and a small plant, a one unit compression plant is considered best from all points.

In fact for extremely rich gases, those yielding 5 to 10 gallons from each 1,000 cubic feet of gas, the compression type of plant is still favored, regardless of the size of the plant. Gases of such richness, invariably come from the older fields, where the output is low and this makes the small plant desirable. Gases in some of the older fields of Oklahoma yield as much as 10 gallons per 1,000 cubic feet of gas. In the Glenn pool field some gas yields 12 gallons. There is very little residue from a gas of such richness.

But in the newer fields of Oklahoma as well as other parts of the Mid-Continent field, the absorption type of plant is come into popular favor and its favor seems to be growing. Gases from these fields, Burbank, Bristow and Tonkawa being examples, are yielding no more than two gallons per 1,000 cubic feet of gas. For such gases the absorption process is best, as was indicated by Bureau of Mines tests conducted by Messrs. Dykema and Neal and since demonstrated by use to such an extent that a prejudice of gasoline manufacturers has been removed.

Development of Natural Gasoline Industry

Discussion follows business from its inception to present high position

By D. E. Buchanan

The accompanying paper was read at the second annual meeting of the Association of Natural Gasoline Manufacturers held in connection with the American Petroleum Institute meeting at St. Louis.—Editor.

Truly "It's an ill wind that blows nobody good."

Little did such men as Andrew Fasenmeyer, William Richards, E. D. Leland, Sutton Bros. & Edmonds and many others realize the immense proportions to which the business of extracting gasoline from natural gas would grow. The presence of gasoline in natural gas was first discovered in the early 80's. The above named men and many other operators of natural gas transportation lines, experienced a great deal of trouble with condensation in the lines. It was soon discovered that this condensate was gasoline and drips were installed in low places and sags along the lines to accumulate and permit the removal of the condensate. As there was practically no market for gasoline at that time the product was generally wasted, at least no commercial use was made of it. It soon became the practice to use it for boiler fuel on the leases but the value of the product was no incentive for recovering it; it was simply a matter of eliminating an objectionable operating condition.

It is recorded that in 1903 Sutton Bros. & Edmonds of Sisterville, W. Va., first established the business of collecting this drip gasoline and marketing it. Of course their facilities for extracting the gasoline were very crude. They used the gas line pressure, installed a few cooling coils and recovered by this process only the heavier gasoline fractions. The gravity was said to have been approximately 70 degrees, Be. This production was collected in wooden barrels and sold in the vicinity of Parkersburg W. Va., for blending purposes. It is pleasing to note that the company which purchased this first drip gasoline has used natural gasoline in increasing quantities every year since that time and is today one of the largest users. This can surely be taken as a forceful testimony of its value and usefulness. Andrew Fasenmeyer was also among the first to commercialize the value of this product.

According to reliable authorities the first plant especially designed and constructed for extracting gasoline by the compression method was built by William Richards at Mayburg, Pennsylvania.

From the time it was discovered that gasoline would precipitate out of natural gas when subjected to pressure and low temperature until about 1907, it was generally thought that all natural gas contained gasoline in commercial quantities and quality and there were many plants of various designs constructed and considerable financial loss encountered before it was learned that only "wet" gas could be treated profitably.

These plants were generally built by producers who made provision to handle only such gas as was produced on their own leases, and it was not until some years later that gas was purchased for the purpose of gasoline extraction. As the business became better established and the market for the product was enlarged, the manufacturers commenced buying "wet" gas from adjoining leases. This was easily contracted on the basis of one-half of the per gallon gasoline selling price per thousand cubic feet, with no regard for gasoline content. Royalty owners usually received $5 to $10, per well, per year for their interest.

The industry grew steadily until in 1911 it became of sufficient importance to attract the attention of the U. S. Geological Survey, and it was for that year that the first production figures were recorded by that body.

As early as 1905 applications were filed for U. S. Letters Patent covering the extraction of gasoline from natural gas by the absorption method, and up to 1911 a great deal of experimental work was carried on by various operators. E. D. Leland is accredited with extracting gasoline from natural gas by this process, in connection with refrigeration, in 1901, which probably was the first gasoline so extracted. In 1913 a plant especially designed to operate under the ab-

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ference of three-tenths of a degree between them.

Some of the refiners though it would be hard for them to get crude without paying a premium. It was agreed the payment of premiums in the past was what brought the change to the gravity schedule and so the refiners were determined to make the premium a thing of yesterday, if possible. To those who argued the independent could not get crude without paying a premium it was pointed out the price of crude would surely go down quickly without the independent refiner in the field. On the other hand, it was shown that if the independents let loose and paid all kinds of big premiums, the effect would be to widen the present schedule.

There has been no immediate effect on refinery prices as a result of the change by the Prairie. That is very evident here, following the refiners meeting, for the past week has shown no material price changes, what slipping there has been being the natural and seasonal change and in no way the result of the new crude-buying schedule.

In fact, the grading of crude, first looked upon with great alarm by the refiners hereabouts, is now generally accepted as a sign for the better. The Mid-Continent refiner has had lots of troubles recently. Freight rates are against him. His distributing area has been restricted by Wyoming. He has not been getting enough money for his output. All that is ancient history. The new price basis for crude will, of course, increase the price of crude to the small refiner. He will have to get more for his finished goods. He will have to fight for that new level and it will be a good thing for him to have to fight, for there has been too much shading of prices by the smaller refiners. In some cases the small refiner will benefit. For crude from 30 to 32.9 gravity that did cost $1.25 now is $1.10, and that is enough of margin to save the refiner who, even if he has to pay a five premium on it, will be able to operate at a profit. Refiners believe that if they hold their gasoline now in storage they are due to make a handsome profit on it.

sorption method was constructed at Hastings, W. Va., and this was probably the first plant of its kind of any consequence.

Growth of Industry.

The growth of the industry from 1911 to the present time has far exceeded any early expectation, the production today being equal to approximately 10 per cent of the total gasoline manufactured from petroleum and its products by all processes.

The accompanying table prepared from records of the U. S. Geological Survey, is of considerable interest, in that it sets forth clearly this growth in gallonage and value from year to year.

Year	No. of plants	Total production gals.	Total value	Avg. per gal.
1911	....	7,425,839	$ 531,704	.072
1912	....	12,081,179	1,157,476	.096
1913	....	24,060,817	2,458,443	.103
1914	....	42,652,632	3,105,909	.073
1915	....	65,364,684	5,150,823	.078
1916	596	103,492,689	14,331,148	.138
1917	886	217,884,104	40,188,956	.184
1918	1004	282,535,550	50,363,535	.178
1919	1191	351,535,026	64,196,763	.183
1920	1184	384,743,922	71,534,118	.187
1921	1161	473,658,500	65,717,900	.14
Total		1,965,434,942	$318,736,775	.162

To the total of 1,965,434,942 gallons, representing the production from 1911 to 1921 inclusive, it is safe to add an average daily production of 1,750,000 gallons for 1922 or a total for the year of 638,750,000 which will bring the total production to 2,604,184,942 gallons. To the value of the product up to and including 1921, it is conservative to add $89,425,000, representing the value of the production for the current year, estimated at 14 cents per gallon, which will bring the total value of the product to $409,060,775. The average prices per year are interesting especially when considered in connection with the average Chicago tank wagon market.

Absorption Gains Favor.

After the discovery that gasoline could be extracted profitably by the compression method from "wet" gas only and on account of the development of the compression process being more rapid than absorption, only wet gas of high gasoline content was sought by gasoline manufacturers.

As absorption methods were improved and perfected the product made by this process gained favor with the trade, on account of the lower volatility and the ease with which the product could be handled for blending as compared with the compression product. Up to two or three years ago all authorities held that the absorption process could not be profitably operated on wet gas and especially wet gas of high gasoline content. Extensive experiments and research work conducted by some of the larger manufacturers have disproved this theory and a number of the largest gasoline plants in the country have already been changed over to the absorption process, many of them operating compressors in connection with such plants to recover the light vapors.

The absorption process is steadily gaining in favor with manufacturers as is the product manufactured thereby still gaining in favor with purchasers. It is here predicted that in the future the straight compression plant will be the exception, regardless of gasoline content, whereas, not so long ago, it was the rule.

Mid-Continent Takes Lead.

In 1907 the first gasoline plant to be erected in the Mid Continent was built in the Glenpool field, but it was not until 1910-11 that the industry became of any consequence in that district. It is in the Mid-Continent field that it has experienced its greatest growth, there being manufactured today in Oklahoma, Kansas, Louisiana and Texas approximately 70 per cent of the total production.

During 1921 it was estimated that the production in California was only 13.5 per cent of the total but many plants, some of them quite large, are now being constructed in Southern California, and it is safe to assume that the production of natural gasoline in that state will be greatly increased within the next year.

The growth of the industry in Texas has been phenomenal in the past two years and the prediction is freely made that in another year, Texas will lead all states in this respect, if it is not now leading them. As an example of the strides being made in this direction, it is interesting to note that one company has increased its gross production from 10,000 gallons per day two years ago to 135,000 gallons per day in Texas alone.

From the crude, inefficient plant of the early days, capable of extracting only a small percentage of the gasoline content, we have the modern plants, both compression and absorption, designed and constructed on scientific principles, many of them monuments to the development of the science of which the industry may be justly proud.

The early plants were operated merely as a side line whereas the plant of today is operated by men especially trained in this particular branch of the industry, their knowledge being evidenced by the recovery of 95 to 100 per cent of the gasoline content of the gas.

The activities of manufacturers have not been directed solely to increase in yield. Great strides have been made in the production of a product used more easily and to better advantage in refinery operations. To meet a demand among refiners for a product that could be used in export gasoline, some of the manufacturers have perfected treating facilities which enables them to market natural gasoline passing the doctor test. The demand for this product is steadily increasing.

Overcomes Adversities.

While the figures above presented show phenomenal growth, it must not be assumed that the present substantial position which this product holds in the petroleum industry was attained without trials or tribulations. During the early days of the development in Oklahoma, particularly in 1910-11, it was at times necessary for the manufacturers, (except those who had been successful in contracting for the sale of their product) to draw their daily production from stock tanks to earthen dykes and burn it. There was practically no market for the product but those who were pioneering the industry had the foresight to recognize the possibilities for the future. They sustained losses in all directions in order to retain their gas contracts which were later to prove of great value.

During this time some of them were building new plants while they were burning the production of the plants they had in operation.

From the condition above recited, the pendulum swung to a period of active demand and the product was readily sold from that time to 1920 at prices which well repaid those who had suffered these losses.

From 1912 to 1919 practically all the natural gasoline manufactured in the Mid-Continent field was blended with low-grade distillates, gas oil and fuel oil, and found a ready market among large buyers.

During the years 1918, 1919 and 1920, on account of the high wholesale gasoline prices f. o. b. refinery, and relatively low tank wagon markets, many jobbers throughout the country attempted to market kerosene blend. This blend was manufactured at a less cost than straight run gasoline, and consequently sold to them at prices enabling them to net more profit than could be realized from handling better grades. As might have been expected this blended product did not prove satisfactory as a motor fuel and in the summer of 1920, it grew into such disfavor that its manufacture was stopped.

With the passing of kerosene

blend, naphtha blend—a combination of natural gasoline and naphtha came into greater prominence as motor fuel. As the market for naphtha blend was enlarged, manufacturers with no experience in making that sort of blend, entered the market, and in a short while, naphtha blend also grew into general disfavor on account of the inferior quality of some of it. This inferior quality was in some cases due to the inexperience of the manufacturer and in other cases due to the inferiority of the naphtha as well as the highly volatile natural gasoline used.

Up to this time the refiner using unblended natural gasoline in his operations was the exception Many of them, from one cause or another, were bitterly opposed to the product. The refiner who did use it met with many obstacles in the sale of his product on account of the propaganda circulated by those who considered it detrimental to motor fuel, dangerous to handle, etc. Their dislike for the product was in many cases justified as there was no standard of quality or uniformity in the products sold by different gasoline manufacturers. With a few exceptions it was of such high gravity and so volatile that the refiners facilities did not enable them to handle it profitably or even properly.

Coincident with this growing tendency to discontinue the use of natural gasoline and its blends, came the general depression in the oil business, in fact, in all lines of business. The natural gasoline industry had at no time in the past been on a sound substantial foundation and consequently was in no position to receive the shock. True, many companies had realized handsome returns on their investments, in fact, the returns had been so great that manufacturing costs had not been kept within due bounds.

Prior to this time almost all of the early gas contracts had expired and been renewed on a basis which, when added to the high operating costs, left no profit to the manufacturer when this period of depression came.

GROWTH OF THE NATURAL GASOLINE INDUSTRY IN THE UNITED STATES

Year	Total gasoline produced in U. S. mill. gals.	Natural gasoline produced in U. S. mill. gals.	Per cent of total gasoline	Natural gas treated Mill M. cu. ft.	Average yield M. gals.
1916	2059	103	5.01	209	0.50
1917	2851	218	7.15	429	0.51
1918	3570	283	7.92	449	0.63
1919	3958	352	8.90	480	0.74
1920	4883	385	7.89	496	0.78
1921	5154	474	9.18	469	1.00

GROWTH OF NATURAL GASOLINE PRODUCTION COMPARED WITH GROWTH OF NATURAL GAS CONSUMPTION

Year	Total consumption of natural gas in U. S Mil. of M. cu. ft.	Natural gas tested for gasoline extraction, Mil. of M. cu. ft.	Per cent of total treated
1916	753	209	27.8
1917	795	429	54.0
1918	721	449	62.2
1919	740	480	64.8
1920	798	496	62.1
1921	...	469	....

Due probably to the ease with which they had disposed of the majority of the production in distillate blends, they had made no effort to develop a product that would be useful and desirable in ordinary refinery practice and no attention had been given to the development of a market such as might have tided the industry over these dark days.

Figuratively speaking it was not until the rocks were in sight that the manufacturers realized the necessity for reducing their production costs, manufacturing a more useful product and developing a nation-wide market for such a product. In a very few months through consolidation of plants, efficient operation and economical management, operating and overhead expenses were materially reduced. In many cases gas contracts were revised to a more equitable basis.

Association to Rescue

The industry was at its wits end. Something had to be done and that quickly or the investment of millions of dollars would be jeopardized. In fact, the industry was facing bankruptcy. Accordingly, representative manufacturers met in Tulsa in April 1921, to review their troubles and if possible make some plans for the future which would raise the industry to the plane it had a right to occupy. The outcome of this meeting was the organization of the Association of Natural Gasoline Manufacturers.

One of its first moves was to issue a set of standard specifications for straight, unblended natural gasoline and for blended motor fuel. These specifications made it possible for the refiner to buy the particular grade that best suited his requirements and has much to do with the quick restoration of natural gasoline to popular favor. Particularly is this true of blends which are today meeting with the favorable consideration they deserve. These specifications suited the needs and conditions at the time they were issued but on account of changes in conditions, it was found necessary to revise them slightly. Accordingly its Specifications Committee issued new specifications effective December 1, 1922, which are being sent broadcast over the country to supercede the original specifications.

The term "Natural Gasoline" was created and adopted by the Association to cover all gasoline manufactured from natural gas whether by compression or absorption methods. The terms "compression" and "absorption" are now used only to designate the two general classes under the head of "Natural Gasoline."

The Association as a unit has carried on an extensive educational campaign and some very effective work among refiners has been done by individual manufacturers. In many cases at the request of refiners they have sent experienced men to assist in outlining the most satisfactory methods for handling this product. The organization has also done much to discourage the sale of inferior blends and highly volatile straight natural gasoline.

Refiners Converted.

During the two years of 1921 and 1922 more refiners were converted to the use of natural gasoline than during any previous five year period. The experience of these two years has shown that in refineries properly equipped and where those in charge of the handling of this material have a full understanding of its properties and best methods of handling the loss can be reduced to a minimum of 3 per cent to 4 per cent. The erroneous ideas and prejudices held by many refiners against its use, developed from the knowledge that some few large users have experienced tremendous losses, that would have been ruinous to the ordinary refiner. In condemning the use of the product they have failed to take into consideration the fact that in every case where the results had been unsatisfactory, it had been the practice to redistill the natural gasoline in the presence of benzine and no method had been provided for recovering the vapors that were not condensed in the ordinary refinery operation.

Not long ago refiners, almost universally, arranged their cuts according to their gravity requirements and while it depended altogether upon the particular crude they were running, in many cases it was necessary to cut considerably below the end-point allowed,

in order to make the required gravity. Now they are able to cut for end-point only and build the gravity up by the addition of a small percentage of natural gasoline. From many crudes it is possible, by operating in this manner to take off a thin cut of high gravity, low end-point, straight run, usually 68/70, which is used for special purposes and commands a premium price. This method assures the maximum gasoline yield for skimming plant operation and has resulted in an appreciable increase over the yields obtained by previous methods.

The principal advantage to be gained by the use of natural gasoline is the raising of gravity and lowering of initial boiling points with a product less valuable than the high gravity straight run which must be left in the gasoline unless natural gasoline is used. Even though there be no cut of the high gravity taken off there are many crudes that will produce a product too low in gravity, or with too high an initial boiling point, or both, if cut for end-point irrespective of gravity.

These facts are now well known to all refiners and account for the increase in demand for the product which has been sufficient to keep pace with the increase in production. On account of this strengthened position natural gasoline is now better able to withstand the seasonal declines than ever before.

Future Outlook Bright.

Quite a number of large contracts for shipment over the year 1923 have already been made and from all indications the demand through the winter will be such that these products will not assume the low levels experienced in past winters. The increased production of low gravity crude, together with the decrease in production of light crude, is already having its effect on the natural gasoline market. In past years, during winter months, large quantities of natural gasoline was run to storage as there was little or no demand for it during the season of minimum gasoline consumption. This condition does not prevail at this time and it is doubtful if the slackening in demand over the coming winter months will be such as will result in large stocks being accumulated.

There are two reasons for this conclusion: First, the almost universal use of the product among refiners; second, the steady elimination of the seasonal gasoline demand.

The rapid strides in good road construction and the increased use of enclosed automobiles will, no doubt in time, leave "seasonal demand" as a memory only.

Summing up the development of the natural gasoline industry from its inception to the present time, we find it firmly entrenched as an integral part of the petroleum industry, recognized by all branches thereof. A bright future seems assured.

Great as have been the achievements of the past, natural gasoline manufacturers are not content to rest on their hard-won laurels. Rather are they the more determined that each succeeding year will find their product more firmly established in public favor. They know that their meritorius product is a necessity and a vital part of the automotive transportation of the country and pledge their very best effort to maintain the high position in the petroleum industry which it now occupies.

OUTPUT OF NATURAL GASOLINE 1916-1921, BY METHODS OF PRODUCTION

	By compr.and Vacuum		By absorption	
	Mil. gals. produced	% of total	Mil. gals. produced	% of total
1916	85	82	19	18
1917	169	78	49	22
1918	220	78	63	22
1919	261	74	90	26
1920	281	73	104	27
1921	355	75	118	25

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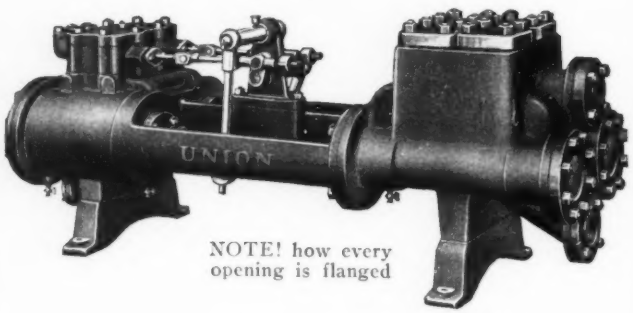

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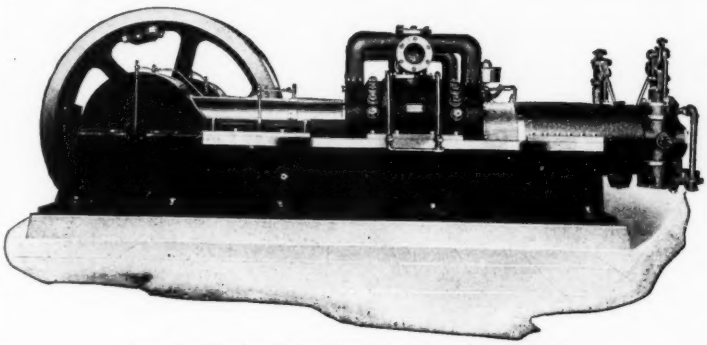

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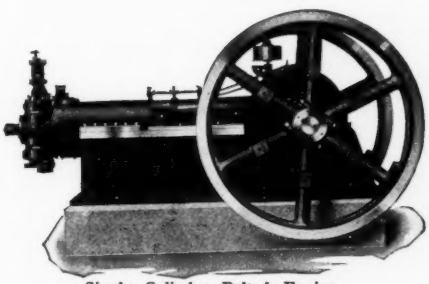

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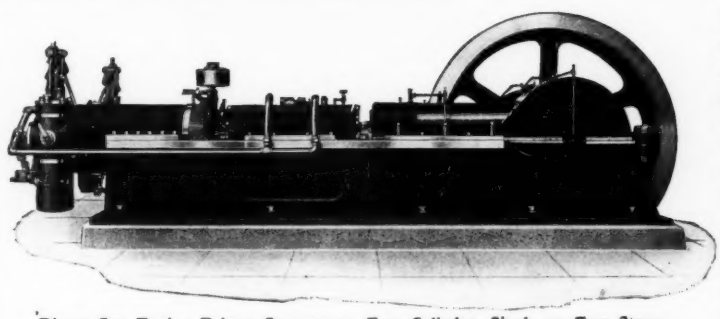

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Destructive Distillation of Oil Shales

Experiment made on product taken from the Green River formation

*By Jacque C. Morrell and Gustav Egloff.**

The oil shale used in the present experiment was derived from the Green River formation, which belongs to the Eocene period consisting mainly of shale. The outcrop which consists of a greyish-white color, but really shows bands of white to grey, was not selected for retorting samples, but those which showed brownish to black appearance on the freshly broken surfaces. This shale was tough and showed no bedding planes, but they were developed by retorting. Plant structure was clearly noted in a number of the pieces which indicated its derivation, and when freshly broken gave the faintest odor of petroleum at times.

Experimental Method

The first apparatus used for distilling the shale was a modification of that used by the United States Geological Survey. The permanent gases formed after being led through an ammonia scrubber were passed successively through a gas meter, a scrubber with 1.84 specific gravity sulphuric acid to remove unsaturated gases and another meter to record unabsorbed gases. The shale was broken up into pieces about three-fourths of an inch square, and a one pound charge was introduced into the retort. The retort was slowly heated with a five Bunsen burner cluster until a dull-red heat was attained, and kept at this temperature for about four hours. The apparatus was then disconnected, the condensed liquids consisting of oil and water placed in a graduate and allowed to stand until a sharp line marked off the oil from the water and the quantity of each was then read off. The liquids were then placed in a separatory funnel, and allowed to stand for about twelve hours, a clean separation then being made. The water portion was added to the liquor (diluted sulphuric acid) from the ammonia scrubber and the ammonia determined by the Kjeldahl method. The oil was later subjected to a distillation analysis, and the various fractions further examined.

Further tests were made to determine solubility, ash, fixed carbon, and volatile matter.

The products resulting from the retorting of one pound of oil shale was not sufficient to make more than the following data in tables No. I and No. II:

Table I.

	Per Cent
Spent shale	84.1
Ash	61.3
Fixed carbon	22.8
Total volatile matter	38.7
Oil	7.49
Water	2.79
Soluble in CS_2	0.13
Ammonia as sulphate of ammonium	1.27

Table II.

Products Produced per Ton		
Oil	20.3	gal.
Total permanent gas	1,947	cu. ft.
Sulphate of ammonia	25.4	pounds

Since the retorting of one pound of oil shale did not give sufficient oil for close analytical results, a larger charge was taken consisting of twelve pounds. For this purpose a horizontal retort was used of 8-inch diameter and length of 18 inches and made of double extra heavy lap welded steel tubing, which was built so as to conduct experiments later of reorting oil shale under vacuum and pressure, thereby varying the type product formed.

Table III.

First drop over water, 136°C. Vapor temperature 190°C. Still temperature

Time	Still Temperature Deg. C.	Vapor Line Temperature Deg. C.
10:55 a.m.	20	20
11:25 a.m.	103	78
:55 a.m.	213	176
12:25 p.m.	315	219
:55 p.m.	358	266
1:25 p.m.	365	*278
:55 p.m.	370	304
2:25 p.m.	400	323
:55 p.m.	(a)	†348
3:25 p.m.	(a)	350
:55 p.m.	(a)	‡355
4:25 p.m.	(a)	360
:55 p.m.	(a)	370

Total retorting time 6 hours.

(a) Above 400°C. Still, reddish, white heat.

*Odor of ammonia.

†Distinctly stronger odor of ammonia.

‡Very strong odor of ammonia.

The method of retorting was by means of direct heating, with a thermometer inserted into a well in the body of the shale, and another thermometer in the vapor line of the retort. In table No. III, the still and the vapor-line temperature are shown. The last hour of retorting showed no liquid or vapors coming over, hence it was concluded that the oil had all been distilled out of the shale.

During the retorting of the shale distillates of oil and water were collected every 100 cc. and the endeavor was made to distill at the rate of 100 cc. per hour. The gravity of the oil portion was taken, and the curious phenomenon was noted that the gravity of the oil in the first fraction was higher than the second and third and then the gravity increased again. The data indicates two maxima and a minimum in the values of the gravity of the various cuts. This is unusual, for the specific gravity of an oil upon distillation increases with increase of boiling point. This phenomenon requires further investigation as it is certain that we have to deal with a different group of compounds from what is ordinarily known. This may be due to heterocyclic compounds. Furthermore, during the retorting of the shale, droplets of liquid falling from the end of the condenser at times were insoluble in the oil layer and passed through the water layer to the bottom of the receiver. This was clear proof that we had to deal with oily material having specific gravity greater than water. There was only a

Table IV.
Products Over from Retorting.

Sample	Total c.c. Over Oil and Water	c.c. Oil Over	c.c. Water Over	Spec. Grav. of Oil 15.5°C.	Baume Grav. of Oil 60°F.
1	100	41.0	59.0	0.837	37.3
2	200	63.0	37.0	0.826	39.5
3	300	73.5	26.5	0.814	41.9
4	400	87.0	13.0	0.887	27.8
5	500	89.0	11.0	0.911	23.8
6	600	83.0	17.0	0.944	18.4
7	676	69.0	7.0	0.961	15.7
Total c.c.	676	505.5	170.5	0.879	29.3

Tests on Composite Samples of Recovered Oil

Baume gravity .... 29.3 Spec. Grav., 0.879
Flash point below. 95°F.
Viscos. Saybolt Univ. 100°F., 32.8
Color 6
Cold test ..... —18°F.

*Chemical and Metallurgical Engineering, Vol. XIX. No. 2.

trace of this material in comparison to the whole and not sufficient to test for; hence, to investigate this point a ton or more of shale would have to be retorted.

It was further noted that as the retorting proceeded the ammonia content of the water layer of the distillation cuts increased, which indicated that the yield of ammonia increases with temperature to a maximum, and then more than likely decreases.

The data is expressed in table No. IV.

Distillation Analysis of Recovered Oil

The color of the recovered oil was a dark brownish red. Upon distillation, the analytical data is given in table No. V, the first 10 per cent of which showed a strong lemon color increasing in intensity until 40 per cent came over. The color of the distillates became darker, merging into wine red, with a black solid residuum in the flask, which showed a tendency toward cracking at a temperature of 360° C. The phenomenon of a liquid coming over during retorting which was partially insoluble in the shale oil and heavier than water has already been referred to. The same type reddish liquid came over in traces upon distilling the recovered oil which was insoluble in the lemon-colored distillate and fell to the bottom of the receiver. What type compound or compounds this represented, as to whether it was a nitrogen or sulphur compound with a low boiling point and high specific gravity, has not been ascertained as yet.

Table No. VI is the distillation data of the crude benzine cut of the recovered oil which was taken as the first 50 per cent over at a temperature of 435° F. and averaged Beaume Gravity of 42.9.

In analyzing the data to arrive at a commercial motor fuel having an end point distillation of a present value of 410° F. and 57-58° Beaume, we find that 85 per cent gives an end point of 405° F. but a Beaume gravity of 45.9°. Although the volatility of the mixture will pass for a motor fuel, the gravity is very low; furthermore, the 85 per cent contains 36 per cent of substances combining with 1.84 sulphuric acid. Upon neutralizing the excess sulphuric acid with 6° Beaume caustic soda and washing with water and drying over calcium chloride, a deep reddish black oil remained which would be

Table V.
Distillation Analysis of Recovered Oil

Specific gravity	15.5°C.	0.8788
Beaume gravity	60°F.	29.3
Per cent unsaturates.		31.0
First drop over	55°C.	131°F.
Rate distillation	5 c.c. per minute Engler Flask	

Per cent Distilled Over	Deg. Cent.	Specific Gravity	Deg. Fahr.	Beaume Gravity Bureau of Standard
5	116	0.7365	240	60.1
10	124	0.7411	254	58.9
15	131	0.7621	268	53.7
20	148	0.7839	300	48.6
25	159	0.7982	320	45.4
30	165	0.8092	331	43.0
35	184	0.8226	364	40.2
40	198	0.8358	390	37.5
45	209	0.8469	410	35.3
50	223	0.8584	435	33.1
55	234	0.8701	454	30.9
60	251	0.8822	486	28.7
65	265	0.8951	511	26.4
70	278	0.9091	534	24.0
75	303	0.9244	579	20.8
80	332	0.9472	630	17.8
85	357	0.9635	675	15.3
90	360	0.9804	681	12.8
8.5 res.	...	Solid	...	Solid

Distillation loss 1.5 per cent.

Table VI.
Redistillation of Motor Fuel Cut of Recovered Oil

Specific gravity	15.5°C.	0.8097
Beaume gravity	60°F.	42.9
First drop over.....	146°F.	63.5°C.
End point	501°F.	207°C.
Distillation range	355°F.	178.5°C.

Per Cent Distilled Over	Degs. Cent.	Degs. Fahr.	Specific Gravity	Beaume Gravity Bureau of Standard	Per Cent Unsaturates
5	79	209			
10	87	227			
15	93	241	0.7527	56.1	36
20	99	254			
25	103	264			
30	107	275			
35	112	286			
40	116	295	0.7923	46.7	33
45	121	306			
50	125	315			
55	130	325			
60	135	338			
65	140	349	0.8235	40.0	30
70	145	359			
75	152	376			
80	158	388			
85	165	405	0.8584	33.1	40
90	175	427			
95	193	467			
End point	207	501	.....	...	..
Per cent Loss	2.5	...	.....	...	..

the so-called motor fuel. For upon redistillation of the refined reddish black "gasoline cut", seventy per cent of distillate was a deep lemon color which upon standing developed a deep reddish-brown color with a Beaume gravity of 47.3 which corresponds to a heavy naphtha in petroleum technology. Much technical work will have to be carried on to refine the crude benzine from oil shale retorting so as to make a marketable motor fuel for internal combustion engines as at present constructed. To work up this oil into a marketable motor fuel is a much more difficult problem than the simple one now presented to the petroleum industry, due to the fact that this oil undoubtedly contains sulphur, nitrogen, highly unsaturated hydrocarbons of the terpene type, aromatic and phenolic compounds.

The higher boiling point cuts show beautiful lubricating oils of similar properties to those obtained from California and Russian oils. The oils must be highly naphthenic in character, and this point will be reported upon more fully in a later paper.

Unsaturated Hydrocarbons

In the cracking of hydrocarbon material in general the four types predominant are:

1. Paraffins.
2. Unsaturated compounds as acetylenes, olefins, and terpenes.
3. Naphthenes.
4. Aromatics.

Since it is generally held that the heat treatment of oil shale is a cracking phenomena, then the type of compounds formed under thermal treatment is a function of the temperature under which retorting takes place. Since this is so then the percentage of unsaturated hydrocarbons in the distillates must be dependent upon the percentage of carbon and hydrogen in the oil shale under treatment at the particular stage of shale decomposition. But, the problem is greatly complexed by the presence of sulphur, nitrogen and oxygen present in the startling material as is witnessed by the decreasing yield of water every 100 c.c. distillate over, and the increase of the ammonia yield with increase of temperature.

In table No. VII, the surprising result is shown of the percentage of unsaturates indicating two maxima, and one minimum value. A maximum of 32 per cent is shown in the first ten per cent cut decreasing to twenty-four per cent and then reaching a maximum value in the last cut. In all thermal[1] and pressure treatment of hydrocarbon material as petroleum oils the perecentage yields of unsaturates increase from a minimum to a maximum and then a minimum value. There is a question as to whether the obsorbed by 1.84 specific gravity acid method[2] registers only unsaturated hydrocarbons.

[1]Egloff and Twomey, Met. and Chem. Eng. 14, 1916.
[2]Ibid.

From the amount of nitrogen and sulphur compound and water distilled over, we may well be dealing with some alkylamines, diamines, imines, amides, thiomides, anilides and nitriles, pyridine, pyrroll and quinoline bases.

Table VII.

Per Cent of Unsaturates in Distillation Cuts from Recovered Oil

Per cent Unsaturates in Recovered Oil, 31.0.

Distillation Cuts Per Cent	Per Cent Unsaturate in Cuts
0-10	32
10-20	26
20-30	24
30-40	26
40-50	30
50-60	36
60-70	40
70-80	50
80-90	Whole mass solid

A. H. Allen[3] gave a series of values upon the reative properties of olefins in shale and petroleum products. He assumed that the relative proportion of olefins present in two products of similar density and boiling points is fairly accurately indicated by the power of assimilating bromine. Hence, the following table No. VIII, would show the relative amounts of olefins present in shale and petroleum products:

Table VIII.

	Shale Prod. Spec. Grav. 15.5°C	Per Cent Brom. in Prod.	Pet. Prod. Spec. Grav. 15.5°C	Per Cent Brom. in Prod.
Gasoline	0.665	41.6	0.652	4.8
Naphtha	0.718	48.7	0.690	8.8
Burning oil	0.801	27.9	0.800	14.7
Burning oil	0.806	26.7	.....	....
Lubricating oil	0.875	31.2	0.862	17.7
Lubricating oil	0.889	36.0	0.905	24.1

Although Allen does not give details as to the method of production, conditions under which olefins formed, and sources of his shale and petroleum products, the data are interesting in qualitatively verifying the data in table No. VII. The shale oil products, as the specific gravity increases, shows a decrease in unsaturates and then an increase similar in nature to those found by the writers. However, it is certain that petroleum products are not complexed to the same extent by various nitrogen, oxygen and sulphur compounds as are the oil shale products.

Aromatic Hydrocarbons

The formation of aromatic hydrocarbons during the decomposition of the bituminous material present in the shale was suspected, hence a test was made for benzene, toluene, xylenes, naphthalene and anthracene. The oil was fractioned by means of a Hempel Column several times, and the cut between 78° and 82° C. analyzed for benzene by using a 2:1 concentrated sulphuric-fuming nitric acid mixture, and heating so as to form dinitrobenzenes. The dinitrobenzenes were treated with alcohol and 1-3 dinitrobenzene crystallized out with a melting point of 89.7° C. Toluene was tested for in the distillation cut from 107°-113° C., by treating with a concentrated nitric sulphuric acid mixture according to the Langenscheidt method.[4] The TNT formed was recrystallized from alcohol and gave a melting point of 80.2° C. The xylene cut of 137-142° C. was nitrated in a similar manner, but care was taken so as not to form benzoic or pthallic acid from the oxidation of the side chains. The 2-4-6 trinitroxylene was isolated by crystallization and identified by its melting point of 181.5° C.

The tests for naphthalene and anthracene were subject to great difficulties due to the large amount of solid paraffin present and their separation was not successful. However, it is unlikely that more than a trace of these two hydrocarbons could have been present due to the relatively low temperature of retorting the shale. The formation of naphthalene and anthracene are relatively high temperature reaction products.[5] But, it is certain that naphthalene and anthracene would form at higher temperatures in the destructive distillation of oil shale.

The percentage of aromatic hydrocarbon formation of benzene, toluene and xylene under the conditions of these experiments was small, but the recovered oil could be retorted again in gas machines and give commercial yields of these products.

Analysis of Water Resulting from the Thermal Decomposition of the Oil Shale.

The water distillate was an amber-colored liquid with a strong odor of ammonia and heterocyclic nitrogen compounds like pyrrol, pyridine and similar substances. The percentage of this water distillate upon the total liquid recovered was 25.2 and upon a weight basis of a ton of shale, 3.0 per cent. The oil and water distillate as the retorting progressed, was collected in 100-c.c. samples. The following table No. IX, gives the per cent of water in the 100 c.c. fractions of oil and water distillates.

Table IX.

100 c.c. Samples	Per Cent of Water
1	59.0
2	37.0
3	26.5
4	13.0
5	11.0
6	17.0
7 (Basis 100 c. c.)	9.2

Upon analysis a composite sample of the water distillate gave the following data in table No. X.

Table X.

Specific Gravity	1.022
H_2S per cent	0.179
CO_2 per cent	Trace
NH_3 per cent	1.580
Ether extrac. per cent	nil (practically)
CS_2 extraction per cent	0.0025
Reaction to litmus	alkaline (strongly)

In the extraction by carbon bisulphide a wax-like solid was separated which had a pungent odor of heterocyclic nitrogen compounds, stronger than the original water solution. No further work was possible on this waxy solid due to the small amount obtained. To investigate this point would require the retorting of at least one tone of oil shale.

Phenols

The formation of phenolic compounds due to retorting oil shale is to be expected, when one considers the amount of oxygen in the starting material, and the percentage of water and oil distillate given off. But, the yield seems to be much smaller than one would be led to expect. Thomas Gray[6] in 1902 treated 3,200 gallons of "green naphtha" obtained from Scotch shale with 28 gallons of (27 per cent) sodium hydroxide solution. The aqueous solution was separated and the phenolic compounds precipitated out of solution with an excess of sulphuric acid which yielded approximately one and one-half gallons of crude phenols called "creosote oil" or 0.047 per cent of the "green naphtha" started with. During the distillation of a portion of this brown oily liquid the odor of sulphur dioxide, and hydrogen sulphide was noted.

Four hundred grams of "creosote oil" upon distillation gave the following results in table No. XI.

Table XI. Creosote Oil

Temperature	Sixth Distillation Grams	Per Cent
Below 195°C.	47.8	11.95
195 to 200	42.4	10.60
200 to 205	49.4	12.35
205 to 210	46.2	11.55
210 to 215	36.4	9.13
215 to 220	22.7	5.68
220 to 230	21.6	5.40
230 to 255	3.7	0.93

The first distillation residue above 230° C. was pitch-like in character and was 16 per cent of the creosote. After thirteen dis-

[3] Analyst 6, 177, 1881.
[4] Z. Ges. Schiess-Sprengstoff 7, 425.
[5] Egloff and Twomey, Jour. Phys. Chem. 20, 121, 1916.
[6] Soc. Chem. Ind. Jour. 21, 845, 1902.

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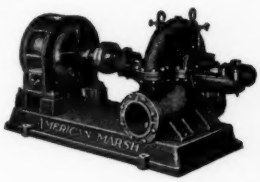

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tillations phenol was found to be present in a small amount. The (o) and (m) cresols were separated but not (p). The 1, 2, 4 and 1, 3, 5 xylenols were identified and a very small quantity of guaiacol. In table No. XII is given the approximate percentages of the phenols, as calculated from the data of Gray.

Table XII.

Phenols from 3,200 gallons "Green Naphtha". 1.5 Gallons Creosote Oil from 3,200 Gallons "Green Naphtha".

	Per Cent in 1.5 Gallons Creosote Oil	Per Cent on Basis of 3200 Gallons "Green Naphtha" Started	
		Gallons	With
Phenol	5-6	0.0825	0.0025
(o) Cresol	12-15	0.2025	0.0063
(m) Cresol ...	15-17.5	0.2438	0.0076
Xylenols	15-17.5	0.2438	0.0076
Guaiacol . ..	very small	.....	.....
Phenols—B. P. above 230°C ..	16.0	0.2400	0.0075

The percentage of phenolic compounds has been calculated on the basis of the 3,200 gallons of "green naphtha" started with, by taking the mean of the values recorded by Gray. These percentage yields indicate the slight phenolic compound formation due to the thermal decomposition of oil shale, when on considers that several hundred tons of oil shale are required to form 3200 gallons of "green naphtha." Despite this large amount of oil shale retored, Gray stated that to separate the phenolic compounds formed, even a larger quantity of "green naphtha" would be necessary; hence, probably, 1,000 or more tons of oil shale retorted would be necessary to determine the various phenols present. It has been stated that American oil shale will produce greater quantities of phenolic compounds than the Scottish. This may be so, but as far as the writers are aware no experimental data has appeared.

In the present work a careful analysis was made of the recovered oil for phenolic compounds, but the sample obtained from the retorting of shale was much too small for anything more than a mere qualitative test. As the above work by Gray indicates, a very large amount of oil would have to be treated to isolate the phenolic compounds present.

A 50-c.c. sample of the cut between 170°-190° C. of the recovered shale oil was treated, with a 20 per cent sodium hydroxide solution, and then neutralized with sulphuric acid. The solution was filtered and distilled, a strong odor of phenol being noted at the end of the condenser. Part of the distillate was treated with bromine water, and a very small slightly yellowish precipitate of 2, 4, 6 tribomphenol was indicated. The distillate was also treated with ferric chloride which gave a violet coloration in the solution which is a characteristic test for phenol, but it must be remembered that other phenolic compounds give violet colored solutions upon treatment with ferric chloride. The phenol present was no more than a trace. A further search was made to isolate other phenolic compounds of the di-tri and tetra hydroxy benzene and hydroxytoluene, xylene and mesitylene, but without success with the amount of oil at hand. A piece of research of the highest importance in connection with American oil shale retorting is to determine the commercial yields of not alone the phenolic compounds of the above type but also as to whether thymol and carvacrol are formed and furthermore, phenol—alcohol—ethers must also be produced of the type of anisole, phenetole and phenol ether, as diphenyl oxide.

Thio-Derivatives of Phenol

Due to the fact, that the water distillate resulting from the thermal treatment of the oil shale under discussion gave 0.179 per cent of hydrogen sulphide, the writers endeavored to isolate and identify thiofen, mercaptans of the paraffin and aromatic types. That thiophenol, phenyl sulphide, thioanisole, thiophenetole and similar compounds are formed is reasonably certain, for their formation is along similar lines to the oxygen alcohols, ethers of the paraffin and aromatic series. In this communication the only sulphur compound isolated and identified with certainty was hydrogen sulphide, and further work along this line awaits the retorting of a very large quantity of shale, as also for the further identification of phenolic compounds in shale oil.

Heterocyclic Nitrogen Compounds

The researches of Anderson,[7] Hoffman[8] and Stenhouse[9] have indicated that when nitrogenous material of organic derivation is subjected to destructive distillation some of the products formed are ammonia and volatile organic bases. It would then be expected that bituminous material like oil shale containing nitrogen would likewise produce heterocyclic nitrogen compounds of the pyrrol, pyridine, quinolint and acridine series, similar to the destructive distillation of wood, bone, coal and the varied nitrogen containing organic material.

Williams[10] working upon a crude naphtha resulting from the retorting of Dorsetshire shale rich in fossilized animal remains isolated a number of heterocyclic nitrogen compounds of the pyrrol and pyridine series. He terated crude naphtha with sulphuric acid to extract the bases. The tarry matter was separated by boiling with water, during which pyrrol was evolved, and tested for by means of fir wood moistened with hydrogen iodide which turned to an intense purplish red. The sulphuric acid was then neutralized with potassium hydroxide and subjected to distillation. A nonbasic oil was separated by saturating the distillation product with hydrogen idodide, and the liquid again neutralized, and distilled. The ammonia was collected by passing through a strong solution of potassium hydroxide in which the bases were insoluble. The water present was taken up and removed by sticks of sodium hydroxide. The liquid was refractionated many, many times and fractions collected every 10°F.

The bases obtained were limpid, colorless and highly refractive. A persistent odor was noted which was pungent. The fractions burned with a smoky flame and fumed strongly in the presence of hydrogen iodide. The bases dissolved in hydrogen iodide with an evolution of heat and formed deliquescent salts. They dissolved readily in alcohol or ether. Upon the addition of cupric nitrate a complex precipitate like $(CuNH_3)_4$ was formed which dissolved in excess. The bases with boiling points below 320° F. dissolve readily in water, but above this temperature to a lesser extent. Those with boiling points below 320°-10° F. gave a beautiful green coloration upon treatment with bleaching powder.

The volatile bases were analyzed by means of precipitation with PtI_4 (author states PtI_2) and crystallization of platinum salts of these bases which is a much more reliable method than distillation. The following heterocyclic nitrogen compounds were isolated and identified from a crude naphtha resulting from the retorting of oil shale.

Pyrrol	C_4H_5N
Pyridine	$C_{10}H_8N$*
Picoline (methyl pyridine)	$C_{12}H_5N$*
Lutidine (dimethyl pyridine)	$C_{11}H_9N$*
New base (?)	$C_{16}H_{11}N$*
Parvoline	$C_{18}H_{13}N$*

*(Formula?)

Beilby[11] believes that animal vege-

[7]Edinburgh Phil. Trans. XX 2, 247. Jour. Chem. Soc. 4, 112, 1852.
[8]Jour. Chem. Soc. 4, 304, 1852. Ibid 3, 279, 1851.
[9]Jour. Chem. Soc. 3, 309, 1851.
[10]Chem. Soc. Jour. 7, 97, 1854. Philo. Mag. 4th ser. vol. 8, 209, 1854.
[11]Soc. Chem. Ind. Jour. 3, 216, 1884.

table matter tends toward the formation of carbonaceous material with the original nitrogen being retained. He states that all oils reacting from the destructive distillation of carbonaceous material containing nitrogen, more or less altered older organic remains, behave much the same as the original substance would have done. Albumen and gelatin and corresponding vegetable matter yield on thermal distillation:

1. Ammonia.
2. Oil rich in alkaloidal bodies.
3. Carbonaceous residue containing large proportions of original nitrogen.

When more or less altered deposits of peat, coal, shale, etc., are distilled a similar redistribution of the nitrogen takes place. A distribution of the nitrogen in shale is shown after distillation in table No. 13.

Table XIII.

	Per Cent Nitrogen
Ammonia in water distillate	17.0
Oil as alkaloidal tars	20.4
Coke residue	62.6

He argues that the nitrogen of the shale started with upon retorting redistributes itself with a higher percentage in the higher boiling point fractions and reaches a maximum in the residue. The alkaloidal tars studied by him were approximately one-fourth by weight of the oil distillate. In the particular distillate studied the oil portion contained 1.16 per cent nitrogen while the alkaloidal tar contained 4 per cent. Upon redistillation of the tar and making ten fractions, the distribution of the nitrogen was, as is shown in table No. 14, although some volatile alkaloids were lost.

Table XIV.

Fraction	Per Cent Nitrogen
1	Lost
2	3.54
3	3.37
4	3.35
5	3.24
6	3.47
7	3.54
8	3.35
9	3.54
Residue	4.00

The latter fractions were subjected to a red heat which indicates the relative stability of the nitrogen compounds. The formation of ammonia from reforming shale is a function of the conditions of temperature, time, retort and other factors, and that when heating is conducted slowly a decomposition of the alkaloids takes place producing more ammonia. The shale referred to above was then distilled very slowly and gave the following results in table No. 15.

The latter experiment shows clearly the time factor in the increasing of the yield of ammonia at the expense of the alkaloids present in the residue coke.

Table XV.

	Per Cent Nitrogen
Total nitrogen	0.70
As ammonia in water distillate	0.23
As alkaloids in oil	0.14
In coke	0.32
Loss	0.01

Calculating on Basis of Total Nitrogen as 100

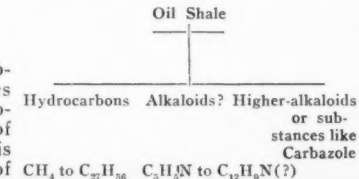
	Per Cent Nitrogen
As ammonia in water distillate	32.8
Alkaloids in oil	20.0
In coke	45.7
Loss	1.5

Beilby made a series of nitrogen determinations of various oils, ozokerite, residuums and coke from Scotch shale. American residuum and coke and Galician ozokerite, the results of which are shown in table No. 16.

Table XVI.

	Per Cent of Nitrogen
Scotch shale oil from retorts	1.160
Scotch petroleum or ozokerite	2,296
American petroleum residuum	0.080
Galician ozokerite	0.188
Scotch basic tar	3.900
American residuum tar	0.710
Scotch crude still coke	3.200
American crude still coke	0.375

The work of Beilby indicates that the nitrogen present in the original bituminous material increases in the latter fractions during retorting reaching a maximum in the residue; furthermore, that during distillation of the shale only the more volatile alkaloids come off and the residue still contains the less volatile or pitchy nitrogenous bodies, and that it is probable that there are series of unbroken continuity from the volatile pyridine, picoline up to pitchy or coke-like substances. Diagrammatically this is shown as follows:



In the present work the heterocyclic nitrogen compounds were not isolated due to the amount of distillate oil and water recovered not being sufficient for a close analysis. Attempts were made to isolate the volatile bases by means of precipitation and crystallization of the hydrochlorides, sulphates and platinichlorides, but too many complexes were formed which we were unable to separate—due to not being able to fractionate the starting material into close boiling fractions. However, that pyridine and its homologs are present is certain, for their characteristically pungent odor was noted clearly. The further study of these heterocyclic nitrogen compounds will be carried on, when sufficient starting material is obtainable. Due to the close analogy of the thermol decomposition products of bituminous material containing nitrogen, oxygen and sulphur, as coal, bone, wood and shale, similar volatile base type products have been isolated. It is suggested that when shale oil is thoroughly investigated, compounds of the furfurane, thiophene, pentamethylene oxide and penthiophene series will be isolated. They are so closely interwoven, synthesized and analogous in their behavior to some extent to the benzenes, phenols and one another as the formation of dimethyl furfurane, thiophene and pyrrol from acetonyl acetone, shows that similar synthesizing must occur when oil shale is subjected to thermal treatment.

Products Recovered on Basis Ton Oil Shale Retorted

In table No. 17, the results from retorting twelve pounds of oil shale are tabulated, with percentage yields of various products. Furthermore, the products based upon a ton of oil shale compare

Table XVII.
Per Cent Products from Oil Shale

Oil shale	Lbs.	Kilo-grams	Per Cent
Charge used	12.00	5.87	...
Spent shale	10.00	4.89	83.3
Oil recovered	0.91	0.45	7.6
Water recovered	0.35	0.17	3.0
Ammonia	0.04	0.21	0.3
Gas and loss	0.61	0.34	5.8

Products per Ton Oil Shale Retorted

Oil	20.7 gal.
Total permanent gas	1,920 cu. ft.
Sulphate of ammonia	23.3 lb.

fairly closely with the results obtained by retorting one pound of the same shale. This particular oil shale from Colorado would average between twenty and twenty-one gallons of oil per ton and approximately twenty-five pounds of ammonium sulphate.

The following list of compounds

have been isolated by various workers in oil shale retorting. They are fairly well diversified, but with further research in all likelihood there will be approximately as many different compounds identified as there have been from coal tar. Shale oil is an exceedingly complex mixture of hydrocarbon, oxygen, sulphur and nitrogen compounds of complex structure, which would require the highest technical skill to separate for industrial use.

Compounds Isolated from Oil Shale Retorting

Carbon monoxide	(a)
Carbon dioxide	(a)
Hydrogen	(a)
Methane	(a)
Ethlyene	(a)
Oxygen	(a)
Nitrogen	(a)
Ammonia	(a)
Hydrogen sulphide	(a)
Benzene	(b)
Toluene	(b)
Xylene	(b)
Chrysene	(c)
Pyrene	(c)
Phenol	(d)
(o) (m) cresol	(d)
Xylenols	(d)
Guaiacol	(d)
Pyrrol	(e)
Pyridine	(e)
Picoline	(e)
Lutidine	(e)
Parvoline	(e)
Quinolins	(c)

(a) Roman J. Soc. Chem. Ind. 10, 436, 1891.
(b) Present research.
(c) Bacon and Hamor American Petroleum Industry.
(d) Gray, Chem. Soc. Jour. 21, 845, 1902.
(e) Williams, Soc. Jour. 7, 97, 1854.

General Summary

1. The derivation of oil shale is in all probability of the same origin as petroleum oil. The formation of bituminous shales is mainly due to slow evaporation of the impregnated oil, vegetable and animal matter in clays before or after being consolidated into shale.

2. The per cent of unsaturates in the distillation cuts of the shale oil showed the unusual phenomenon of two maxima and one minimum. In the first 10 per cent cut the percentage of unsaturates was 32, decreasing to 24 in the 20 to 30 per cent cut, increasing then to 50 per cent unsaturates in the 80 to 90 per cent cut.

3. Benzol, toluel and xylol were present in small amounts in the shale oil recovered.

4. The following phenols have been isolated from shale oil: phenol, (c) (m) cresol, xylenols and guaiacol.

5. Pyrrol, pyridine, picoline, lutidine and parvoline have been found in shale oil.

6. Scotland in 1916 produced 600,000 gallons or 14,260 barrels of gasoline or 0.7 per cent on the total oil recovered from the retorting of 3,500,000 tons of shale. The amount of gasoline produced in the United States in 1916 was 2,500,000,000 gallons. Sotland's production calculates 0.00024 per cent of this amount. The United States exported 110,000,000 gallons of gasoline to the United Kingdom of England in 1917.

7. The oil-shale industry of France is declining, and from government reports France is practically dependent for her oil supplies upon foreign countries.

8. In New South Wales the industry has declined for a number of years, and is at the present time more or less at a standstill. The tons of oil shale retorted dropped from 59,426 in 1895 to 17,425 in 1916.

9. The following tabulation covers the gallons of oil yield per ton of shale retorted in various countries and localities of the United States:

Shale from	Gal. Oil Per Ton	Pounds Ammonium Sulphate Per Ton	Average
Utah	25.0	13.3	38*
Wyoming	16.4	15.0	42*
Colorado	16.2	19.1	51*
Pres. Research Colo)	20.5	24.4	2*
Scotland	23.0	38.0	3,500,00†
Canada	34.9	51.3	44*
France	20.7	(a)	184,030‡
New South Wales	(a)	(a)	17,425‡
Black Shale:			
Pennsylvania	27.6	(a)	7*
Illinois	14.0	(a)	2*
Indiana	10.0	(a)	7*
Ohio	7.1	(a)	4*
Tennessee	5.2	(a)	13*
Kentucky	5.1	(a)	3*
W. Virginia	1.4	(a)	5*
Cannel Coal:			
Missouri	51.4	(a)	6*
Illinois	34.6	(a)	2*
Pennsylvania	29.6	17.2	5*

(a) Not determined.
*Samples.
† Tons shale.
‡ Tons.

In prospectuses, and a number of articles appearing in the oil journals of the country for calculating possible profits from oil shale retorting, the gallons of oil per ton of shale taken, range usually between 42 and 60. But, the above data indicate clearly that an average of shale retorting one-half these values would approximate the gallonage yield of oil per ton of shale retorted. The three states Utah, Wyoming and Colorado have been most carefully studied and the average of 133 samples collected approximate 20 gallons of oil per ton shale retorted.

10. It has been stated that there is sufficient shale in Colorado to produce twenty billion barrels of oil from which two billion barrels of gasoline may be extracted by the ordinary methods of refining. It is certain that no such amount of gasoline is obtainable from twenty billion barrels of oil resulting from retorting Colorado shale. Although nine samples distilled gave approximately 10 per cent of distillate with a volatility similar to gasoline, it is however, not a gasoline suitable for internal-combustion engines. It is a distillate composed of paraffin hydrocarbons, unsaturated hydrocarbons, nitrogen compounds, sulphur and oxygen compounds. In fact, the complexity of the distillate due to the presence of alkaloidal bases, sulphur compounds and phenois, make it impractical to refine by the ordinary sulphuric acid-caustic soda method prevalent in ordinary refinery practice. Scotland has averaged less than one per cent of marketable gasoline from her shale retorting experience of over fifty years. Can we reasonably expect ten times as much gasoline from the retorting of Colorado shales, than Scotland does from her shales? The experimental evidence shows that the 10 per cent distillate of gasoline volatility from shale oil, will suffer a heavy loss upon refining to produce a marketable gasoline suitable for internal combustion engines; furthermore, that nothing like 10 per cent or 2,000,000,000 barrels of gasoline will result from the refining of 20,000,000,000 barrels of shale oil from Colorado shale.

11. It is estimated that Southeastern Indiana is underlaid with shale-bearing oil which contains 100,000,000,000 barrels of oil.

12. That oil shale is of the highest importance as a potential source of oil is certain. This has been recognized by our government in setting aside shale lands for the use of the navy. The ultimate commercial importance of a shale oil industry in the United States is taken for granted. That it will be an industry requiring very large capital in these days of large capitalization is also positive. At the present time no large shale retorting plants are in existence in the United States, and the cost of installing one is problematical. Furthermore, much experimentation will have to be carried on and the highest technical skill will be required to develop a shale-oil industry in the United States.

—Department of Chemistry, Columbia University, New York City.

PERSONNEL OF THE INDUSTRY

JUDGE JULIUS A. GERMANY
Vice President Panhandle Refining Company, Dallas

Victor H. Smith of Lion Oil and Refining Company, Kansas City, Missouri, was among the refiners attending the annual meet of the American Petroleum Institute at St. Louis, and he wanted everyone to know that Arkansas as an oil state had already arrived with a bang.

V. E. Jackson, sales manager of the Texhoma Oil and Refining Company of Wichita Falls, Texas, was a visitor in St. Louis during the past month, where he spent several days on company business.

C. C. Clayton, president of the Clayton Oil and Refining Company, Dallas, Texas, was in New York during the early part of December.

D. H. Christman, vice president of the Clayton Oil and Refining Company, Dallas, Texas, inventor of the Christman process of refining crude, spent a few days in the Shreveport district during the past month.

Paul F. Miles, president and manager of the Absorption Gasoline Company with headquarters in Fort Worth, made a business trip through the Mid-Continent district during the month and stopped over in Tulsa for several days.

I. G. Abney, general sales manager for the Louisiana Oil Refining Corporation with headquarters at Shreveport, La., visited the Fort Worth offices of the Montrose Oil Refining Company, a sister organization, during the early part of December.

K. Tsunoda and D. Matsuzawa, representatives of the Nippon Oil Company, Ltd., of Tokio, Japan, were in Chicago for several days last month on business.

H. J. Halle, president of the Universal Oil Products Company, has recently returned to his headquarters in Chicago from a trip to European countries.

Herbert Stork, formerly in charge of offices of the McCormack Oil Company in Tulsa, is now in charge of the Transport Refining Company, with offices in the Atlas Life building in Tulsa. Associated with him are H. B. Huddleston and W. G. Teaney, both formerly with the McCormack Company.

R. C. Cook, with the Galena Signal Oil Company, of Houston, Texas, was a Chicago visitor during the month.

Sherman S. Clark, of the Fred G. Clark Company of Cleveland, has resigned his position to become general manager of the O'Donnell Refining Company of Los Angeles. J. R. McConnell will be superintendent of the new company, which has just completed a refinery near Whittier, California.

W. E. Proctor, traffic manager of the Island Refining Corporation, New Orleans, La., is back at his work again after two months of illness.

H. M. Blackmer, for six years president of the Midwest Refining Company, at a recent meeting of stockholders was elected chairman of the board of directors. He was succeeded by Thomas A. Dines, vice president of the company.

Richard W. Fleming of New York City, inventor of the Fleming process of cracking oils, was in Fort Worth early this month making an inspection of a 300 barrel daily capacity unit of the process just completed in the Star Refining & Producing Company's skimming plant located in Arlington Heights, near Fort Worth.

D. J. Peters, formerly with the Transcontinental Oil Company and the Penn-Okla Oil Corporation at Pittsburgh, has become associated with Wm. F. Lusch as point representative of a number of eastern refiners.

R. E. Benner, sales manager of Keen and Wolf Company of Houston, Texas, was in Kansas City during the month in company with Louis Rothermel, sales manager of the Deepwater Oil Refineries, also of Houston.

Lubricating Oil Specifications Are Discussed at Washington

Washington, Dec. 19.—Proposed changes in the classification of lubricating oil specifications were discussed at a joint meeting of the Interdepartmental Petroleum Specifications Committee, the Advisory Board to the Committee, the Lubricants Division of the Society of Automotive Engineers, and the Technical Advisory Committee of the American Petroleum Institute, held in Washington, D. C., November 13, at which N. A. C. Smith, petroleum chemist of the Bureau of Mines, presided.

Separate schemes for classification were presented by representatives of the Society of Automotive Engineers and by the Navy Department. After considerable discussion, it was brought out that a difference exists between turbine oils for land service and turbine oils for marine service; also, that for turbine oils with paraffin base and asphalt base, lubricants seem to have the same effective viscosity at about 130 degrees Fahrenheit.

A special committee, composed of William S. James of the Bureau of Standards, Dr. T. G. Delbridge of the Atlantic Refining Company, and H. C. Mougey of the General Motors Research Corporation, which was appointed to consider a list of descriptive names to be used for lubricating oils in the Federal specifications, for explanatory purposes only, reported a majority opinion that four names should be used together with descriptive number; light oil, to cover S. A. E. Numbers 15 and 20; medium oil to cover Number 30 and 40; heavy oil to cover Number 50; extra heavy oil to cover 660, 80, 95, 115. It was voted to accept this majority report as the sense of the meeting. A minority report, which follows the present classification adopted by the Navy Department, was also submitted.

The conference recommended the measurement of viscosities of oils up to 500 series at 100° F.; 600 series and higher at 210° F.

It was further decided to request the Interdepartmental Committee to omit requirement for organic acidity from all motor oil specifications; also to make investigations into the relation between acidity, emulsion tests and service tests; also into the relation between oxidation and evaporation and service tests.

The conference also discussed color, carbon residue and pour test requirements for lubricating oils and the fire point for mineral seal oil. The Inter-Departmental Committee has taken all of these proposals under consideration and will take decisive action at a meeting to be held later.

Extension of Facilities at Tulsa

North American announces a substantial increase in its **tank car repair facilities** at West Tulsa.

These facilities, together with those maintained at Chicago and Coffeyville, provide a convenient and comprehensive service to which the smallest or largest job may be entrusted with full confidence that it will be done right and at reasonable cost.

At Blue Island, Illinois, (in the Chicago switching district) North American maintains extensive facilities for the storage of loaded cars. Your inquiries are invited.

North American Car Co.

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Coffeyville, Kansas 1003 Daniel Bldg., Tulsa Okla.

Celite Products to Be Represented in Tulsa

Tulsa, Okla.—A new company headed by L. C. Converse, formerly of Houston, Texas, has opened sales offices in Tulsa. The new concern will carry a complete line of oil insulating material and in addition to the other lines will continue to represent the Celite Products Company of Chicago, manufacturers of Sil-O-Cel.

The company will take over the business in Oklahoma of the Abbott-Converse Company of Houston, which latter concern will continue to do business in Texas as usual.

R. S. H., Houston, Texas. I would like to have you tell me how to overcome the difficulties experienced in conducting a distillation of crude oil containing water, and especially a heavy viscous oil.

A.—Several methods are available, either of which will probably suffice for your needs.

1. Instead of applying the source of heat directly to the bottom of the distillation flask, heat the whole flask by playing the flame over the bottom, sides and neck. This prevents the water from condensing in the neck of the flask, which would subsequently run back into the hot oil and cause violent foaming, and even a slight explosion which would possibly blow out the thermometer and cork. When all of the water has been removed this way apply the heat to the bottom of the flask and continue in the usual way. This method is quite satisfactory except that the heating of the neck makes accurate vapor temperature reading impossible until all of the water has been removed. If the water content is more than a trace the distillation of the mixture will be similar to a steam distillation or a distillation at a reduced pressure, and the temperature will be lower than when distilling the oil free from water.

2. Remove the water as above and allow the contents of the flask to cool to room temperature. Separate the oil and water in the distillate, return the oil to the distillation flask and conduct the distillation on the dehydrated sample, making proper allowance for whatever percentage of water the oil contained.

3. The United States Bureau of Mines describes a method in Bulletin No. 207 which is admirably adapted to the dehydration of crude oil emulsions. In this method the oil is heated in an autoclave with anhydrous calcium chloride to approximately 392°F., shaken for five minutes and allowed to cool immersing in cold water. By this means the oil is completely dehydrated and suitable sized samples may then be removed, and the distillation conducted in the usual way. Crudes containing a relatively high gasoline content should be shaken again after cooling in order to insure thorough mixing. Otherwise the gasoline which vaporized might form a thin film over the surface of the oil and an average sample would not be obtained.

A. B. D., San Antonio, Texas. I have frequently heard it said that by putting a few moth balls in the gasoline tank of an automobile, the miles per gallon of the fuel is increased. Can you give me any definite information on this subject?

A.—As you say your question is one that is often asked. Moth balls are made from naphthalene which is produced in the distillation of coal tar. Naphthalene is a solid, crystalline, highly volatile hydrocarbon which burns without leaving a residue. Results of experimental tests are at hand which were made to determine the consumption of solutions of naphthalene in benzine, and of pure benzine in a motorcycle. These results show that a 15 per cent solution of naphthalene yields 3.4 per cent more mileage than straight benzine. The 15 per cent solution was the highest that was found practical without choking the carburetor with a solid deposit of naphthalene. Assuming that approximately the same ratio would hold good for gasoline and gasoline-moth ball solutions, we find that it will take in the neighborhood of 10 pounds of moth balls to give a 15 per cent solution in a 10 gallon gasoline tank. This may give an increased mileage of 3 or 4 per cent as seen above, and would probably be worth while as moth balls are fairly cheap, but it would hardly seem logical to suppose that the addition of a few moth balls or even fifty of them would make much difference in the mileage produced by the motor fuel.

"If two fuels are selected having the same heat value per gallon, that which is richer in hydrocarbons could be used at a higher efficiency, that is at higher compressions. The advantage gained by using a fuel rich in aromatics is therefore, twofold. Not only are most units obtained per gallon, but those heat units can be utilized in a more efficient manner."[1]

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[1]Kewley—Petroleum Times. 6,750 (1921)

A. O. C. Cambridge, Mass.—What is a straight distilled gasoline?

A.—A straight distilled gasoline is that which is obtained from a crude by ordinary methods of distillation without the aid of any cracking process, etc. For example, straight distilled gasoline to meet navy standard specification would be the products of distillation of a crude from the first over or the lightest distillate down to a point at which the entire distillate together would have the boiling points and other qualities prescribed by the navy standard ot specifications. Other gasolines made by cracking processes meet with navy and other specifications and may even give more mileage than straight distilled gasoline, but cannot properly be termed straight distilled.

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Distillation of Raw Natural Gasoline

Most common blending material now used in Mid-Continent field is 50-52 naphtha

Before a volatile gasoline can be transported in tank cars, it is necessary to decrease its volatility in order to lessen the risk of fire or explosion, as well as to prevent excessive evaporation in transit. This can be accomplished either by weathering the gasoline, or by blending it with a more stable material, naphtha being commonly used. In the weathering process the more volatile portions of the gasoline are allowed to evaporate and the losses in volume are very large. Therefore, blending is preferable, wherever possible.

It is very difficult, however, to produce by blending, in gasoline plants a motor fuel which is equal to straight-run refinery gasoline. In order to make a blended motor fuel of a grade equal to straight-run gasoline, only a small percentage of natural gasoline can be blended with the naphtha, consequently it is customary to blend the gasoline with only enough naphtha to enable it to be shipped to an oil refinery when the material is again blended to form a finished motor fuel.

The addition of natural gasoline to straight-run products is often necessary, first, to balance the large amount of high-boiling material included in the gasoline fraction in modern refineries, and second, to supply the deficiency of low-boiling material in certain crudes.

In the past, blends were frequently made with kerosene and were subsequently distilled, the kerosene merely acting as a carrying agent for the natural gasoline. However, this rerunning was found to be rather expensive on account of distillation losses due to the volatility of the natural gasoline. This particular type of blend was also tried as a motor fuel, but proved to be very unsatisfactory.

The most common blending material now used in the Mid-Continent field is a naphtha ranging in gravity from 50 to 52°B, with an end point of 450°F, or less. When this naphtha is blended with natural gasoline, the vapor pressure and Baume gravity of the blend is much lower than in the raw gasoline, and there is not enough high-boiling material to injure the resultant motor fuel when this blend is added in small amounts to straight-run gasoline.

It is not necessary to use 50-52° naphtha for blending with natural gasoline, as there are other comparatively volatile petroleum distillates that will accomplish the same purpose. It is quite possible to use straight-run gasoline of 56-58° B. gravity as a blending material, when the object of blending is that of bringing down the vapor pressure to conform with shipping regulations. It has been found that blends made with either 50°B. naphtha or 56°B. gasoline, blended in the same proportion with natural gasoline, will give almost identical vapor pressures. This possibility can be made use of to advantage when 50°Be. naphtha commands a higher price than 56°B. gasoline, or when naphtha is temporarily unobtainable. The Bureau of Mines has found that by rerunning kerosene in the Bartlesville experimental refinery, 20 per cent of 46°B. naphtha with an end point of 450°F. could be obtained.

The present price of kerosene is so low that many refiners are mixing the unfinished material with fuel oil and gas oil instead of refining it. An opportunity, therefore, exists for the rerunning of kerosene distillate and obtaining a naphtha with an end point of 450° F. It should be pointed out, however, that to get yields comparable to those obtained by the Bureau, efficient fractionating towers must be used.

The naphtha produced in this way is an excellent blending material and will reduce the vapor pressure of the gasoline to the same extent as 50°B. naphtha. It would not, however, produce a blend which is suitable for motor fuel when used alone, as the mixture would contain an excess of both low-boiling and high-boiling fractions and would be deficient in the hydrocarbons that have medium boiling points. This blend can, however, be advantageously added to straight-run gasoline, since the natural gasoline contained in it will furnish the required low-boiling material.—U. S. Bureau of Mines, Reports of Investigations.

Chickasaw Plant to Be Sold at Public Auction

Oklahoma City, Okla.—The Chickasaw Refining Company at Ardmore in this State is to be sold at public auction. The decision to dispose of the plant came after a board of appraisers had made their report to the company's creditors.

The Chickasaw Refining Company's plant is rated as a 5,000 barrel plant.

TABLE SHOWING DISTILLATIONS OF RAW MATERIAL GASOLINE BLENDING NAPHTHAS AND RESULTING BLENDS

	Vapor Pressure Lbs.	Gravity °Baume	First Drop °F	10% °F	20% °F	30% °F	40% °F	50% °F	60% °F	70% °F	80% °F	90% °F	95% °F	Dry Point °F	Distillation Loss %
Raw Gasoline	16¼	85.3	88	90	97	108	122	142	167	199	289			289	18
46.4°B. Naphtha.				264	282	298	316	329	342	358	374	401	424	450	2.5
*Blend (50% Raw, 50% 46°B. Naphtha)	8¼	63.7	95	122	151	196	246	284	313	347	378	415		435	8.0
56.4°B. straight-run gasoline		56.0	127	190	210	230	250	266	288	318	336	367	397	432	2.0
*Blend (50% Raw, 50% 56.4° straight-run)	8¾	69.2	92	108	123	150	180	220	260	298	332	416		421	9.0

*These blends are not intended to represent finished motor fuel but simply indicate the proportions used to reduce the vapor pressure of the raw gasoline. By D. B. Dow (Assistant petroleum chemist, Bureau of Mines).

Cracking Process Discussed by Standard

An old operation worked out to meet the requirements for additional gasoline output

By Frank A. Howard *

In answer to recently published articles on complications arising from patents on the so-called Cracking Process, the Standard Oil Company, New Jersey, through its publication, The Lamp, has clearly stated its position in the matter. The accompanying article is reprinted from the October issue of The Lamp and was written by the Standard Oil Company's technical expert. —The Editor.

As used in the petroleum industry, the term "cracking" signifies generally the conversion by decomposition of a heavy or viscous oil of high boiling point, into a lighter, free-flowing oil of lower boiling point.

Specifically, the term "cracking" at the present time is almost universally applied to that particular species of decomposition by which gas oil or fuel oil is converted to yield a substantial percentage of gasoline.

Historically, the art of cracking goes back approximately one hundred years, at least. This, of course, not in the modern petroleum industry, which has not had that length of life, but in the allied gas and coal-distillation industries. Animal and vegetable oils, waxes, fats, and resins appear to have been subjected to an operation which we should today call "cracking," in the very earliest days of the gas industry, for the purpose primarily of converting them into illuminating and fuel gas. Almost as early, various natural bituminous substances, such as coal, shale, lignites, and more rare mineral deposits, which came very near to being solidified petroleum oil, were subjected to destructive distillation, both for gas production and for the production of light oil distillates. The earliest general use of this method of destructive distillation for the purpose of causing decomposition of complex bituminous into lighter oils appears to have taken place in connection with the shale and coal oil industry in England, where "cracking" processes of this description were very early utilized to increase the yield of refined oil, or kerosene.

Cracking for this purpose became a standard operation in the petroleum industry soon after it got on its feet commercially in America, and the process was highly developed in American refineries. By the aid of this method, the supply of refined oil, which was at that time the petroleum product in greatest demand, was very greatly increased. In the case of many crude oils the yield of kerosene obtained by cracking equalled the yield of natural kerosene so that in effect the kerosene production was in these instances actually doubled by cracking.

In the early years of the present century, when the demand for gasoline began to outstrip the demand for kerosene, it was natural that the oil refiner should turn to his prior cracking processes for inspiration and help in solving the new problem. The earliest process for cracking to produce gasoline which proved successful on a large commercial scale was that developed by Dr. William M. Burton and his associates, of the Standard Oil Company (Ind.). This process was a pressure distillation method, the details of which were worked out so successfully by Dr. Burton and his associates that within two or three years there were several hundred stills operating according to the method in use, not only by the Indiana Company but by a large number of licensees as well, located in all parts of the United States. The success of the process and its widespread use may be attributed not only to its intrinsic merits but also to the circumstance that its details were worked out in such a manner that it fitted into existing refinery processes and organizations so perfectly, requiring the minimum of special knowledge, either in construction or operation, and the minimum change in the accepted refinery practices aside from the pressure distillation itself.

The Burton process, of course, was not the only one which came forward at this time, for the subject of increased gasoline supply was one of great importance to the whole industry, and refiners, as well as chemists, engineers, and outside inventors and scientists of all descriptions, were diligently at work on other processes. The historical background of the cracking art, involving as it did not only petroleum refining but the earlier industries of gas manufacture and coal and shale distillation, gave a fertile field in which inventors seeking to improve cracking for the production of gasoline could operate. It will be remembered that the Federal Government itself became interested in this matter, through the Bureau of Mines, and that much publicity was given to a process known as the "Rittman Process," the initial work on which was done under the auspices of the Bureau of Mines.

It was unfortunately a fact that in many instances, perhaps the majority of instances, the inventors and promoters of the numerous cracking processes which began to clamor for public attention and financial backing, very soon after the Burton process became generally established, either were unfamiliar with or failed to point out the historical background of the problem. It was believed by most persons not familiar with the details of the industry that cracking was an entirely new phenomenon and method; that the Burton process was the only known means of accomplishing this; and that anyone who was able to produce gasoline by cracking in a manner different from that of the Burton patents would be assured of a fortune. The facts of the matter were quite different, i. e., cracking was not essentially new, nor was it by any means true that the Burton process was the only method by which gasoline could be obtained from heavier oils. Almost any one of the hundreds of prior cracking processes which had grown up in the three related industries of petroleum, gas, and coal, were available, sometimes without change at all and sometimes with only the very simplest changes for the production of gasoline from heavy oils. Like every other practical proposition, it was a question of the dollars-and-cents results which was the final criterion. For one reason or another, almost none of these competitive processes could be actually used on any large scale

*Technical expert Standard Oil Company, New Jersey. Reprinted from the October issue of The Lamp.

by the average petroleum refiner with any profit to himself. Either the gasoline yield was too small, or the quality bad, or the losses too high, or the processing costs excessive, or the equipment too dangerous or too costly, or some other single disadvantage or combination of disadvantages worked to outlaw the process from the practical refinery. At least half a dozen sizable fortunes have been sunk in efforts to convince the refining interests of the country of the practical value of the more energetically promoted of these processes. Much that was of real merit was involved in many of the processes, and some of them actually gained a precarious foothold in the industry.

It was inevitable that a development of this kind, involving such a large industry, and of such great importance financially, should become the subject of a host of patents. Several hundred patents have been issued dealing with cracking processes in the last ten years. The lack of any general knowledge on the part of the public as to the nature of a patent right is in large part responsible for the confusion which has existed with respect to cracking patents and with respect to their speculative or investment value.

It should be understood that a patent is not the grant of a right by the Federal Government to practice a certain invention, make a certain machine, or use a certain process. Every person has an inherent right to engage in any lawful business, and this right is neither extended nor limited by the grant of a patent right to him for an invention which he proposes to use. The right which the grant of a patent does establish is not the right to practice the patented invention, but solely the right to **prevent others from practicing the specific novel point of the invention.**

It is almost universally the case that an invention consists of a combination of something that is new with something that is old. In the art of cracking oil, the patents, without exception so far as we know, do not even purport to cover fundamentally the operation known as "cracking." They obviously could not do so, for this operation, under the same or another name, is at least one hundred years old. What the patents do cover, each of them, is some particular combination of steps, or pieces of equipment arranged for use in some definite fashion. Perhaps no single one of the pieces of equipment or the steps of procedure will be new in itself; perhaps the novelty will consist only in its application in that particular combination.

In other cases, the novelty may consist in the addition of some single new step or piece of equipment to an apparatus or process which was in toto old with the exception of that new part. For example, in the cracking art, probably two-thirds of the patents which have been issued relate to improvements in the same general method used in the Burton process, i. e., distillation of the heavy oil under pressure. These improvements take all forms; they deal with the temperatures and pressures at which the distillation takes place, the form of the equipment used, the treating of the resulting products and every imaginable variant. The Burton patents themselves, although generally regarded as the pioneer patents in this field of gasoline production by pressure distillation, do not purport to cover the mere act of pressure distillation to produce gasoline, but are limited to this process as carried out in a particular fashion, which, in the judgment of the patent office, was new with Burton and his associates.

It follows from the above that almost all of the patented cracking methods, which have formed the subject of the large number of patents issued within the last few years, are themselves infringements of some one or more other patents, depending upon the basis upon which the inventor started to work. This fact, which is an inherent result of the nature of our patent system, has led to much misunderstanding and bitterness. Persons have invested large sums of money in the development of cracking methods only to discover what they could have found out by a five minutes' talk with a patent attorney in the first instance, i. e., that the method could not be used without securing licenses from perhaps one and perhaps a dozen earlier patentees whose separate inventions were involved in the particular method which they were endeavoring to commercialize. A situation of this kind naturally becomes the more complex in proportion to the number of patents which are co-existing in the same field at any particular time. The importance of the cracking art naturally attracted inventors to such a great extent that there is perhaps no single patent situation which is more confused than this one. The situation has been made even worse by reason of the fact that the Patent Office has been laboring under difficulties in the way of inadequate funds and an inadequate staff during the past five years, resulting not only in the grant of some patents the validity of which may be seriously questioned but also in the almost indefinite holding up of applications for patent. Since an inventor has a right to rely upon his application date as his effective date for most legal purposes, and since applications for patent, according to the rules of the Patent Office, are kept secret until they issue, it follows that even though a worker or inventor has developed a method which is free of infringement of any existing patent, he must

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RECENT REFINERY PATENTS ISSUED

Washington, D. C.—The following patents of interest to the refining industry have been recently issued by the United States Patent Office at Washington.

Cracking Hydrocarbon Oils

No. 1,435,652, issued on November 14 to John L. Murrie, Yonkers, N. Y., a process for cracking hydrocarbon oils distilled from crude petroleum, shale oil, and oil obtained from gilsonite or similar hydrocarbon-bearing material, and apparatus therefor, comprising, in the cracking of hydrocarbon oils, the described process consisting in introducing the material to be treated in conjunction with a permanent hydrocarbon gas into the lower part of a molten metal bath in a retort, collecting the resulting vapors and gases in the upper part of the retort, conveying them away and condensing them, continuously supplying to and withdrawing from the surface of the bath a layer of the heavy fractions and unvaporized hydrocarbons which holds the carbon impurities in suspension, and adjusting the thickness or depth of the layer as required.

Refining Liquid Hydrocarbons

No. 1,435,824, a process of refining liquid hydrocarbons issued on November 14 to Albert Ernest Dunstan, of Sunbury, England. The patent comprises a process for refining liquid hydrocarbons containing sulphur compounds, comprising subjecting said hydrocarbons to treatment with a solution consisting of hypochlorite and free alkali without introducing chlorine into the liquid hydrocarbons.

Oxidizing Liquid Hydrocarbons

No. 1,436,136, issued to Ernst Zerner, Vienna, Austria, on November 21. A process for oxidizing liquid hydrocarbons consisting in dissolving all the unsaturated compounds contained therein by liquefied sulphurous acid, evaporating the sulphurous acid contained in the undissolved residue, and blowing the residue thus refined with a current of an oxygen-contained gas.

No. 1,436,214, issued on November 21 to Gustav Teichner, Vienna, Austria. A process for oxidizing liquid hydrocarbons, which consists in removing those hydrocarbons which tend to form resins and asphaltic substances from the initial hydrocarbon material and then subjecting the hydrocarbons to oxidization, in the presence of an oxygen-transferring catalyst, until a product of saponification value far in excess of 30, is obtained.

A process for oxidizing liquid hydrocarbons, which consists in removing those hydrocarbons which tend to form resins and asphaltic substances from the initial hydrocarbon material by refining with fuming sulphuric acid and blowing the refined hydrocarbons with an oxygen containing gas, in the presence of an oxygen-transferring catalyst, until a product having a saponification value far in excess of 30, is obtained.

A process of oxidizing liquid hydrocarbons which comprises removing from a mineral oil material those ingredients thereof which on blowing with air tend to produce asphaltic or resinous bodies, and introducing an oxygen-containing gas into such purified oil, in the presence of a zinc compound capable of serving as a catalyst to aid the formation of a saponifiable material.

No. 1,436,362, issued on November 21, to William R. Seigle, New York, N. Y. The method of producing an oily composition of substantially permanent constitution, which consists in partially hydrogenating tung oil, dissolving gilsonite in said oil, and thereafter substantially completing the molecular saturation of the oil by polymerization under heat.

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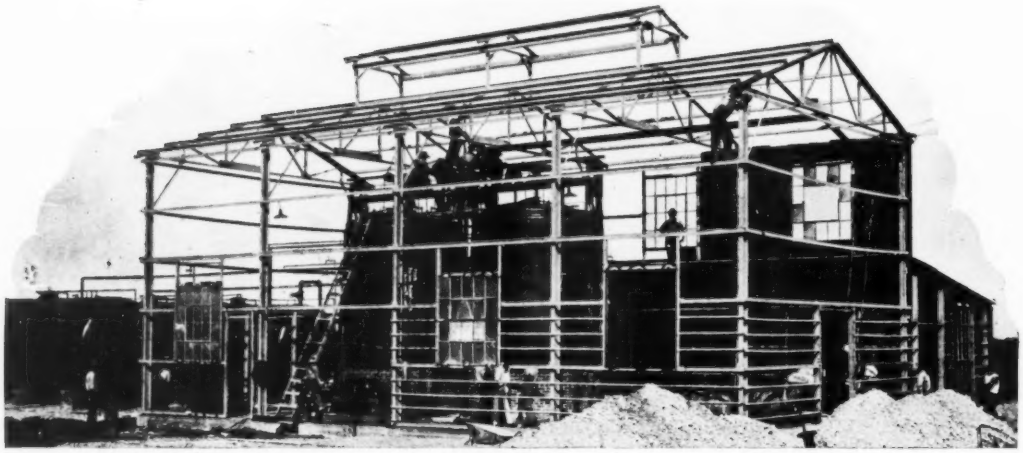
still face the risk of the issue of a patent on a long-delayed application antedating his own and which will cover his own method.

Just this fate has several times overtaken the Burton process—patents issued several years after the Burton patent was issued, and purporting to cover various phases of the process which had been worked out by the Indiana company and its licensees and employed on a large scale, totally without knowledge, or means of knowledge, of the existence of the other inventors. The Dubbs suit in which the Standard Oil Company (Ind.) is now involved is the result of one such delayed patent.

The Standard Oil Company (N. J.) has been a licensee under the Burton patents and has operated large numbers of Burton stills for many years. It has during that period devoted considerable amounts of time and money to research and experiments on cracking, and, as a result of this work, has been able to greatly improve the efficiency of operation of its Burton equipment. A further and more important result of the same work, however, has been the development of a process, known as the "Tube-and-Tank Process," which is just now going into extensive use in the refineries of the company. Based on the experience with it up to the present time, it is believed that this method will be in many respects superior to the Burton method, and since it does not infringe the Burton patents, nor, so far as can be determined, any other existing patents, the company is relieved from the payment of license fees in its operations under the new process. The company's patent position on the "Tube-and-Tank Process" is in part the result of its own work and in part the result of its acquisition of the Ellis patents, which date back to 1914, thus affording some degree of security against future difficulties arising from the issue of delayed applications of others which may have been held in the Patent Office for many years.

There has been promoted recently, under the name of the "Cross Process," a cracking method which resembles that developed by this company, and which is believed to infringe the Ellis patents. Suit has been brought against the Pure Oil Company of Ohio under the Ellis patents for the operation of this Cross process.

It is not the intention of the company to attempt to monopolize the "Tube and Tank" cracking method, but, on the contrary, a liberal licensing policy has been adopted with respect to this process. The Beacon Oil Company of Boston, Mass., took such a license some time ago, and is in operation under it at the present time. The royalty rate fixed for the use of the process is ten cents per forty-two gallon barrel of heavy oil cracked. Licenses will be granted to any reputable company on these terms.



"Sealite" plant of the Humble Oil and Refining Company while under construction at the company's Baytown refinery

New Product Reduces Evaporation Losses

"Sealite" a foam type solution has been worked out by Standard of New Jersey

The practical elimination of evaporation losses in storage tanks with a resultant saving of millions annually, is the claim of a new product recently worked out and tested in the laboratories of the Standard Oil Company, New Jersey. The product, known as "Sealite," has been developed only after several years of research work, and is now ready to be offered to the industry.

The new method is based on the principle of sealing in the lighter vapors thrown off by petroleum and its products, while in storage, with an air-tight blanket in the form of a foam resting on the surface of the stored product. Other experiments on the "blanketing" idea have been made, but finding a suitable covering or solution in the past has always halted operations along this line.

In compounding a foam that would float on the surface of even the lighter petroleum products and at the same time be air-tight, the Development Department of the Standard Oil Company has worked out a chemical solution of which glycerine, glucose and glue form the basic chemicals. The portion of glue used makes the product of such "stickability" that it is almost impossible to tear it apart.

Sealite in its first state has the appearance of brown molasses with a weight of about 11 pounds to the gallon. Before the solution is applied to the tank it is put through a mixer with compressed air which increases its volume about three times and lowers the weight per gallon to around 4½ pounds. After going through the mixer Sealite becomes a rich cream color and has very much the appearance of foam.

Applied Through Vents

Application is made by pouring the Sealite through the vent holes in the roof of the tank after which within a few hours it spreads until the entire surface has been covered. Sufficient Sealite is used to make a covering of about one inch in thickness on crude oil and about two inches on gasoline and other lighter products.

The chemical composition of the product is of such nature as to react against grease which keeps Sealite from sticking to the walls of the tank and makes it possible to lower or refill tanks without any damage to the foam.

Acts as Fire Prevention

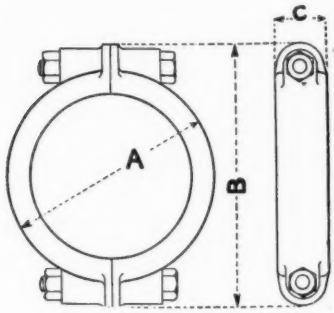
By eliminating the accumulation of gasses and vapors in the space between the surface of the oil and the roof of the tank, Sealite carries out a two-fold purpose in that it reduces to a minimum the fire hazards. Its manufacturers claim that due to the readiness with which the solution spreads and seals together again after having been broken, that should fire break out in a tank covered with Sealite, that within a few minutes the product would smother the flames.

The extent to which the evaporation has been reduced is shown by tests on 55,000 barrel tanks of crude, where after Sealite had been applied it was almost impossible to smell the gas or vapors usually overcoming when opening the vents on the roof of the tank. Other tests made over a period of time on a number of gasoline storage tanks show that the evaporation of this product can be reduced approximately 75 per cent.

While as yet definite figures have not been arrived at, it is estimated that a 120 foot tank, or the largest storage tank made, can be

Putting Sealite in storage tank on Humble's Webster farm

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



Cross section of Victory Pipe Joint

Victory Pipe Joint Is Meeting With Success

The Victory Pipe Joint Company, Ltd., London, England, has recently issued a new catalog describing the company's joint and also states that the new type of joint known as the "B" joint is proving very successful.

The "B" Joint as shown by the accompanying illustration is made in two half-housings which use bolts to hold together and is used with tubes having expanded, grooved or thickened ends and works, according to the company, with the same efficiency as does the flange joint.

One of the outstanding features of the "B" joint is that fitting can be accomplished in any space into which a man can get. The only tool used to place the joint is a spanner six inches in length. Since the half-housings will not bolt together unless the ring is correctly placed it is almost impossible to make a mistake in placing the joint and a satisfactory joint can be made in the dark or under water.

Gasoline Evaporation Is Tested in Oklahoma

Tulsa, Okla.—A test has been completed showing the relative rates of gasoline evaporation from bare and insulated tanks at the plant of the Bigheart Producing & Refining Company, Bigheart, Okla.

This test was made with casinghead gasoline made by the absorption process from oil well gas, with a specific gravity of 74 degrees Baume.

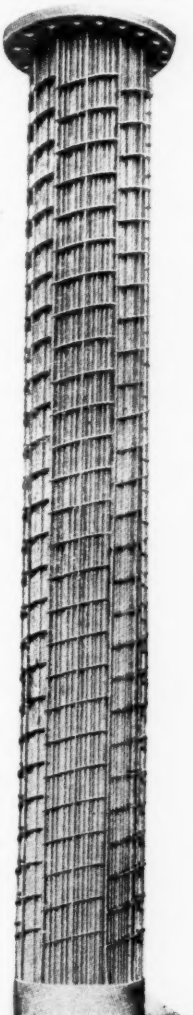
The engineers of Johns-Manville, Inc., and the U. S. Bureau of Mines used two tanks under roof, each 7 feet 6 inches diameter by 9 feet 7 inches long; the first bare, and the other insulated against outside changes of temperature.

Two thousand nine hundred and seventy-five gallons of gasoline were put into the tank, and 2998 gallons into the insulated tank. Both tanks were allowed to stand full for eleven days with the gasoline under an average pressure of 4 pounds to the square inch. The results from this test were as follows:

The evaporation loss from the bare tank in ten days was 182 gallons, while the loss from the insulated tank was only 77 gallons of gasoline in ten days, making a difference of 105 gallons, in favor of the insulated tank. This, at market value of 20 cents a gallon, would be worth $21.10, or $2.10 a day. The cost of insulation, as applied, was approximately $300, which the insulation would earn in 143 days. Figuring on a monthly basis, the savings per month would be $63, yielding 21 per cent a month on the investment.

Griscom-Russell Co. Has New Exchangers

The Griscom-Russell Company, 90 West Street, New York, has recently placed upon the market several new pieces of apparatus for use in refineries and natural gasoline plants. Principally among these is the company's Multiwhirl exchanger and the G-R Vaneflo exchanger. A new catalog has been issued by the company which describes the two products in detail and can be secured from the company's headquarters.



G-R Vaneflo Heat Exchanger

The company claims that the Multiwhirl or Vaneflo exchangers give a high heat transfer rate with small friction loss. The new exchangers are of compact sturdy construction and take up very little space when placed.

The Multiwhirl exhanger has been patented while the Vaneflo now has patents pending.

Copies of the company's catalog "Oil Refinery Apparatus" is now ready for the trade.

Humble Covers Tanks

The Humble Oil and Refining Company has just recently covered fifty of its storage tanks on the company's Webster tank farm and announce that the new process is meeting with very satisfactory results.

The solution is the result of the personal efforts of F. A. Howard, Dr. Robinson, J. M. Jennings and G. H. L. Kent, all members of the Standard Oil Company of New Jersey and in whose names the patents on the process have been granted.

The Standard Oil Company holds the rights to the process and will license it out to companies in the various oil districts on a royalty basis, which companies will in turn manufacture and offer the Sealite to the general trade.

The Humble Oil and Refining Company has been granted the rights to the southwestern territory and the company has installed a plant in connection with its refinery at Baytown, Texas, and is now making preparations for marketing the product.

covered at an approximate cost of between $2600 and $2700. Due to the fact that sufficient time has not expired since the discovery of Sealite it is hard to estimate just how long one covering of the solution will hold up. However, tests so far show that after a year's service the foam practically maintains its initial quality.

Sinclair Vinita Plant Is Moved to Muskogee

Chicago, Ill.—Sinclair Refining Company has disposed of its gasoline marketing properties in Wichita, Kansas, and closed the company's branch office there. The business in the Wichita territory will be handled from the Kansas City offices of Sinclair.

The Vinita plant of Sinclair Refining is being moved and consolidated with the company's Muskogee refinery.

Kansas City Structural Steel Company Catalog

All of the latest ideas in catalog printing have been incorporated in the new issue of the Kansas City Structural Steel Company, Kansas City, manufacturers of tanks for oil field and refinery use. The arrangement of the book is such that it is easily read and the contents make it of permanent value.

In introducing the new catalog to the trade the company states that the purpose of the book is to impress upon the prospective buyer of refinery equipment the importance of ordering from adopted "Tank Standards."

The book is free to the trade and will be supplied by the company upon request.

Homestead Valves

The Homestead Valve Manufacturing Company, Homestead, Pa., has just issued Catalog No. 30 which is one of the most attractively displayed catalogs to reach our desk some time.

The new booklet outside of carrying the usual catalog features has a number of interesting articles and tables giving the various uses of valves.

The Homestead Valve Manufacturing Company has now been organized for thirty years, starting at a time when valve manufacture was in its infancy.

New English Patent

A new British patent has recently been granted to Dr. A. E. Dunstan, of Meadhurst, Cadbury Road, Sunbury-on-Thames, for an invention relating to the refining of liquid hydrocarbons and applicable to the refining of benzine, kerosene or other distillates from shale oil and the like by the removal therefrom of sulphur compounds.

The present invention has among its objects to remove part of the remaining sulphur content after treatment with alkaline hypochlorite.

According to the invention the liquid hydrocarbon, after first being treated with alkaline hypochlorite, is treated with alkali, whereby the sulphur content is materially reduced.

Furthermore, the liquid hydrocarbon before being subjected to treatment with alkaline hypochlorite, is treated with alkali, by which the sulphur content is reduced, and thus the amount of the sulphur content to be removed by the hypochlorite treatment is also reduced, and any bodies possessing an acid reaction are removed. Thus by this preliminary treatment the hypochlorite is protected from decomposition and notable economy effected in the use of this re-agent.

In carrying the invention into effect the preliminary treatment may be effected with .5 to .75 per cent of caustic alkali made up to a 10 per cent solution. After agitation of the said solution with the liquid hydrocarbon to be treated, over a period of one hour, or more or less according to the sulphur content in the liquid hydrocarbon to be treated the solution of caustic alkali is separated from the liquid hydrocarbon and the liquid hydrocarbon is then subjected to treatment with alkaline hypochlorite, such as sodium hypochlorite.

The treatment may be effected within the vessel in which the solution of salt, such as brine, is electrolyzed for the production of the hypochlorite, or the treatment may be effected within a mixing apparatus external to the electrolytic apparatus. Heat may be applied to the vessel in which the treatment is effected, so that the liquid is maintained at a temperature of, for example, 120°F., which has been found effective. The treatment is effected in the presence of free alkali so as thus to inhibit chlorination of the hydrocarbons and to stabilize the hypochlorite and to assist in the removal of the products of the treatment which result in the removal from the oxidation of the sulphur compounds originally present in the liquid hydrocarbon treated. After treatment with alkaline hypochlorite the liquid hydrocarbon is subjected to a further washing with alkali. For this purpose a solution of caustic soda may be used, whereby the remaining content of sulphur compounds is further reduced. This treatment may continue under agitation, for example, for a period of one hour, and the solution of caustic soda may be used for the preliminary treatment of another batch of the liquid hydrocarbon.

The soda for the preliminary soda wash may be recovered by steaming off from it an oil rich in sulphur, the residual soda being then available for use.

It will be understood that the invention is not limited to the apparatus used for carrying out the steps involved in the treatment according to the invention, as any vessel ensuring intimate admixture and contact of the liquid hydrocarbon with the re-agent used may be employed—Petroleum Times.

Omaha Plant Operating On Salt Creek Crude

Omaha, Neb.—Crude oil from the Salt Creek field is being used in charging stills of the Omaha Oil Refining Corporation, which recently took over a plant here. E. T. Williams, president of the company, is an oil producer in the Wyoming fields.

Casper, Wyo., Dec. 11.—Eight stills are being added to the refining plant of the Mutual Oil Company here. Other additions to the plant include a new receiving house, four new boilers and two storage tanks of 55,000 barrels capacity each.

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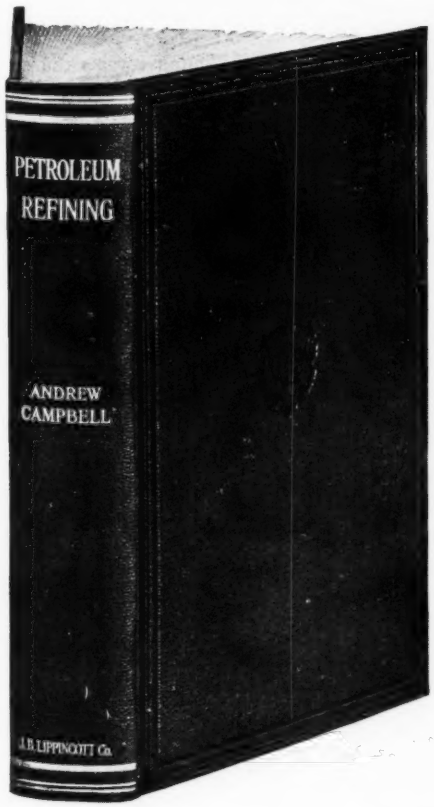
The Refiner and Natural Gasoline Manufacturer is the only periodical devoted exclusively to the refining and natural gasoline business. Its subscription price is a dollar a year—your check will do.

Petroleum Refining



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When Can Gasoline Be Classed As Good?

Gravity as basis of quality fast losing ground—Distillation test being required

The idea that all gasoline is good does not exist; however, it is well known that many refineries do make good gasoline, and too that gasoline is offered as a good, clean, sweet product, free from water. One still hears the question, "what gravity does your stock test?" Surely the time will soon be here that suestions of that type will not be asked by anyone in this country since so much attention has been paid of late to educating the people that gravity as far as indicating the quality of gasoline has absolutely no meaning whatsoever. It is impossible to establish a gravity test that will mean anything to the automobile driver.

At one time, gravity was assumed as being an index to gasoline quality. At that particular time when little or no gasoline was sold and straight out gasoline was cheaper than kerosene: but those days are far different to the present time when the demand is excessive, every available portion of the crude is worked into gasoline, cracking processes are present everywhere, and besides the casinghead gasoline business is here. A general mixture of all these products in one little bottle and what would gravity mean? The only result would be the original duty assigned it and that to indicate how many pounds is contained in a definite volume.

Stillman Uses Gravity Test

The man in charge of the receiving house for a battery of stills still clings to gravity test and possibly will always do that unless the "cuts" from the still are governed on a temperature basis alone. The stillman has a very good reason for clinging to the gravity scale for he is acquainted with the physical tests that accompany the various gravities of the stocks that he is overseeing. Yet, for one of these men to judge a gasoline good because the gravity is high would be an exception.

Distillation Is Important

The distillation test stands out as possibly the one big method for the determination of the value of gasoline. The test itself is a simple one and proves conclusively the percentage of extremely low boiling hydrocarbons present as well as regards the existence of high boiling fractions.

The necessity for low boiling fraction is obvious for winter use. There should be, for the Southern country, an initial of at least 125 degrees Fahrenheit and the initial merely means the temperature at which the first drop from the gasoline will fall from the end of the condenser. If the initial boiling point is too low, the low boiling fractions may be excessive, which is proven one way or the other by continuing the distillation and noting the percentage at 221 degrees Fahrenheit. An excess of low boiling fractions is not desirable for evaporation losses are too great, however, sufficient stock to permit the motor to start quickly on a cool morning is very welcome.

The temperature of the distillation is gradually increased and percentages are recorded at various temperatures. The highest temperature reached in the distillation is known as the end point and this point is a very positive indicator of whether the gasoline is poor or rich in regard to the boiling fractions. The navy specification for gasoline calls for an end point not in excess of 437 degrees Fahrenheit. For economic reasons the gasoline should include all the heavier fractions that rightfully belong to this particular classification, but caution should be exercised in using as a motor fuel a gasoline containing heavy ends or fractions that are in the kerosene class.

Distillation reveals the composition of the gasoline, something that gravity cannot do, hence it is the logical test to judge the quality.

Is Your Gasoline Sweet?

Maybe you are not acquainted with the fact that one good point about good gasoline is that it is sweet. This is a real test and gasoline is sweet if it will not impart a dark color to the sulphur or the doctor solution which is composed of litharge and caustic soda. This test indicates that the gasoline is not fully refined, for gasoline should not possess a sour odor. The odor is due to certain types of sulphur compounds that are decomposable.

Color of Gasoline

The color should be water white and any deviation from this point means another feature of incomplete refining that shows up. The gasoline may be of good color when it leaves the refinery. However, if the doctor test is not good, more than likely a yellow color will develop. While color may mean little to the average man, yet a refiner should not be pleased unless the color of his stock is water white. The visible gasoline pump if filled with off colored motor fuel will surely detract from the sale of such a product. One does not have to possess a knowledge of chemistry or be adept in the principles of oil refining to know that a yellow or brownish color gasoline is what is not wanted for motor fuel. There will be more or less a tendency on the part of the passerby to wonder why the color is present. From the point of operations in a refinery, there is no need, as has been said, if the details of the processes are watched sufficiently. Incomplete fractionation of the vapors from the still is not to be corrected by a treatment with chemicals.

Unsaturated Hydrocarbons

The unsaturated hydrocarbons have come into prominence in gasoline manufacture since pressure stills have become of so much use.

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PIONEERS IN MID-CONTINENT FIELD SPECIALIZING ON
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VAPOR TOWERS AND ALL OTHER
REFINERY TANKAGE

REFINERY AND GASOLINE PLANT ACTIVITIES

Producers Gasoline Co. New Oklahoma Concern

Okmulgee, Okla., Dec. 11.—Another company has been added to the list of natural gasoline manufacturers of Oklahoma with the formation of the Producers Gasoline company, a $1,000,000 Delaware corporation.

The purpose of the concern, which is a closed corporation, is to build and operate natural gasoline plants in the Okmulgee district of Oklahoma.

Officials of the company are W. B. Pine, president; C. W. Wangerine, secretary-treasurer; H. Wirshing, vice president and general manager. Directors are John T. King, W. E. Wood, W. B. Pine, C. W. Wangerine, J. M. McCulloch, H. A. McLain and H. Wirshing.

Lubrite Increases Capacity Of Its St. Louis Plant

St. Louis, Mo.—The refining capacity of the Lubrite Refining Company's plant at East St. Louis will be increased as a result of extensive improvements now being made.

Lubrite Company officials have announced that the stock interest the company held in the Cabell Petroleum Company have been disposed of and that Lubrite no longer has an interest in the concern.

This series of petroleum varies from the products of the straight run gasoline in that there is a lack of hydrogen atoms in their structure. However, the presence of these in small quantities do not interfere with the quality of the gasoline. The Bureau of Mines states that up to twelve percent of unsaturated products may be used without causing any motor trouble. It is even considered that quantities in excess of 12 per cent may be considered satisfactory. Some claims have been made that straight cracked or unsaturated gasoline is within itself an efficient fuel for the motor. However, we do not know of actual proof of this statement. The automobile owners have nothing to fear from this type of hydrocarbons as the manufacture of this product is much in the minority compared to straight run gasoline.

Water in the Gasoline

It is not the intention of any refiner to ship out a barrel, tank car or ship load of gasoline with even the slightest haze. It must be clear and free from moisture before a shipment is made. Many people feel that the water is actually put into the gasoline by the manufacturer to increase the volume, but never, for this feature of cloudy gasoline or cloudy products of any nature is constantly fought by the refiner.

Hoisting a huge cracking still into its upright position was made comparatively easy through the use of block and tackle with the pull obtained from a Clark Cleanout Machine recently at the Grayburg Oil Company's refinery in the Somerset field near San Antonio, Texas. This still weighs approximately 30 tons, and is a part of a cracking unit being added to the refinery to crack gas oil and distillates. Eight-inch steel pipe carefully reinforced at the joints was used as uprights for the cross beam that supported the block.

Chemical Equipment Association to Begin Work; Offices in New York

The Chemical Equipment Association, comprising manufacturers of equipment essential to manufacture in the score or more of chemically controlled industry of the continent, has established national executive offices at 1328 Broadway, New York City.

It has begun active work through a national membership for the fostering of trade in chemical equipment, and for the improvement of practices in the production and distribution of such equipment, and in the performing of engineering services incidental thereto.

Not only does its activity signalize the adoption of trade association methods by the companies constituting the equipment base of the nationally vital chemical industries, but it represents a movement toward manufacturing and distributing co-operating in these same strategic points that has attracted the attention of Secretary of Commerce Hoover, who personally encouraged the organization of the Association and has elicited such comment as this from the New York Tribune, which said, in its issue of November 5th, quoting an officer of the Chamber of Commerce of the United States:

"Such supply company organizations as the Railway Equipment Association, The Motor and Accessory Manufacturers Association, The Association of Ice Cream Supply Men, the recently formed Chemical Equipment Association, and other groups representing the supply and equipment ends of leading industries, the members of which are manufacturers of miscellaneous commodities, but 'connected with a specific industry', for market expansion, educational work, publicity, research, credit protection, and prevention of trade abuses is one of the most interesting current trade association trends."

The Chemical Equipment Association was organized September 12th, 1922, following preliminary activities of an organization committee of representatives of leading manufacturers.

The officers of the Association are: President, Pierce D. Schenck, President, The Duriron Company, Inc., Dayton, Ohio; Vice Presidents, J. George Lehman, Vice President and General Manager, Bethlehem Foundry & Machine Company, Bethlehem, Pa; Walter E. Lummus, President, The Walter E. Lummus Company, Boston, Mass; Adolph Coors, Jr., Vice President, Coors Porcelain Company, Golden, Colorado; Treasurer, Percy C. Kingsbury, Chief Engineer, General Ceramics Company, 50 Church St., New York City; Secretary, Roberts Everett.

The directors are: H. N. Spicer, The Dorr Company, New York City; P. S. Barnes, The Pfaudler Company, New York City; Edwin C. Alford, T. Shriver & Company, Harrison, N. J.; T. C. Oliver, Treasurer-General Manager, Chemical Construction Company, New York City; Hamilton Allport, E. B. Badger & Sons Company, New York City.

The Association has already established communication with nearly two hundred of the large industrial associations of the country annoucing itself as a source of information in chemical equipment supply matters, and has begun a regular bulletin service to members. The Association is, further, arranging details of a permanent co-operation with the Department of Commerce in the collection and dissemination of vital trade information.

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Comar Gasoline Plant Is Nearing Completion

Ponca City, Okla., Dec. 11.—The natural gasoline plant of the Comar Oil Company in the Tonkawa field is to be completed by January 1. The plant, located in the southwest quarter of the northeast of section 10-24-1 west, will have daily output of more than 5,000 gallons of gasoline daily.

Star Adds Another Unit To Plant at Arlington

Fort Worth, Texas—The Star Refining & Producing Company has added a 300 barrel daily capacity unit of the Richard W. Fleming process of cracking oils to its 2,000 barrel skimming plant located in Arlington Heights, near Fort Worth. The initial run of the cracking unit was made on Thanksgiving Day, and is now being operated regularly. The storage facilities of the plant have also been increased about 5,000 barrels as result of the increased output of the plant.

Oklahoma Has Three New Gasoline Plants

Tulsa, Okla.—Three new natural gasoline plants are being started in Oklahoma.

At Cushing the Home Gas Company is building a compression plant of two units.

Hutchinson & Becker of Okmulgee are installing a one unit plant at Preston, Oklahoma.

The National Products Company of Cleveland has ordered three compressors and one auxiliary engine for a plant to be built at Terlton.

All these plants are installing Bessemer equipment.

Osage Mutual Will Resume Operations

Tulsa, Okla.—Operations at the old Osage Mutual refinery located at Pawhuska in the Osage Nation in this State are to be resumed shortly, according to an announcement by the new owners of the plant, Kansas City and Cushing oil men.

The plant will be equipped with new machinery. The new owners are J. H. Ward of Kansas City and E. A. Hawley of Cushing, Oklahoma.

Kansas Has New Million Dollar Refining Concern

Wichita, Kans.—The Mecca Refining Company with a capital stock of $1,000,000 has been organized here and the concern's charter has been approved by the Kansas state charter board. Kansas City and California capital is backing the new company, it is understood.

Incorporators of the new refining company include R. R. Worley, A. M. Bush and Lola B. Brooks. It has been annouced that the new company will erect a refinery here within the near future.

New Oklahoma Refinery To Be Built by Braden

Perry, Okla., Dec. 11.—A site of 80 acres has been provided here as a refinery site for Glenn T. Braden of Tulsa. Material is ready for shipment and construction of the plant is due to begin shortly.

Champlin Builds Plant In New Tonkawa Field

Tonkawa, Okla.—The second natural gasoline plant for the Tonkawa field is being built by the Champlin Refining Company and the Peppers Gasoline Company both of Enid. The plant is being built on the Plumb farm in the northeast quarter of section 10-24-1 west.

Lone Star Builds Compression Plant

Oklahoma City, Okla.—The Lone Star Gas Company expects to complete by the first part of December their compression plant near Pernell in the southwestern Garvin County oil and gas field in this State. Gas will be taken from more than twenty producing gas wells in the territory.

REFINERY STATISTICS FOR NINE MONTHS

Comparative Anaylsis of Production and Consumption for the First Nine Months of 1919, 1920, 1921 and 1922. (Unit of Gallons)

GASOLINE

	1922	1921	1920	1919
Stocks January 1	586,087,132	462,381,837	446,793,431	297,326,983
Production	4,483,805,326	3,841,675,557	3,499,723,473	2,920,073,193
Imports	56,471,446	28,907,583	34,706,851	9,322,518
Total	5,126,363,904	4,332,964,977	3,981,223,755	3,226,722,694
Exports*	446,469,636	396,832,696	465,439,992	268,166,964
Shpts. to insular poss.**	14,145,168	22,761,119	16,312,386	12,889,050
Domestic consumption	3,975,698,291	3,398,045,164	3,211,275,983	2,574,541,261
Stocks September 30	690,050,809	515,325,998	288,195,394	371,125,419
Total	5,126,363,904	4,332,964,977	3,981,223,755	3,226,722,694

KEROSENE

	1922	1921	1920	1919
Stocks January 1	341,008,555	393,070,923	339,319,690	380,117,829
Production	1,630,448,603	1,417,116,813	1,680,881,001	1,670,221,425
Total	1,971,457,158	1,810,187,736	2,020,200,691	2,050,339,254

LUBRICATING

	1922	1921	1920	1919
Stocks January 1	240,863,516	160,522,477	137,318,934	138,853,574
Production	712,356,103	642,309,993	771,403,821	620,098,533
Total	953,219,619	802,832,470	908,722,755	758,952,107
Exports*	253,198,961	194,350,580	297,426,907	207,286,353
Shpts. to insular poss.**	1,830,928	3,462,098	3,505,484	3,062,113
Domestic consumption	483,461,919	374,792,379	477,340,535	389,636,571
Stocks September 30	214,727,811	230,227,413	130,449,829	158,967,070
Total	953,219,619	802,832,470	908,722,755	758,952,107

Figures on imports, exports and shipments to Insular Possessions are taken from reports of the Bureau of Foreign and Domestic Commerce. As the monthly import and export figures have been slightly revised the corrected totals for the nine months ending September have been used above. This changes the consumption figures slightly, the above figures being correct. *Does not include shipments to Philippine Islands. Exports of Gas and Fuel Oil include fuel or bunker oil laden on vessels engaged in foreign trade as follows: 1919, 8,823,959 barrels; 1920, 18,304,693 barrels; 1921, 20,252,215 barrels; and 1922, 23,572,378 barrels. **Includes Philippine Islands, Hawaii, Alaska and Porto Rico.

÷ REFINERY SUPPLIES ÷

Chemical Market Is Unchanged Over Month

Chicago, Ill., Dec. 4.—There can be discovered no definite trend in the market for chemicals used by refiners at this time. The improvement in the market reported last month is maintained, in general. Only two products have advanced in price during the month. Nitrate of soda has advanced about 10 cents per hundredweight. World supply of this product is quite satisfactory, but receipts in this country have been rather light, while the demand has been good. Price is not apt to advance further, but may remain at present level.

Acetic acid is half a cent stronger due to further advances in price of acetate of lime. Demand continues satisfactory even at these prices, except that from export sources, which is cautious. Sellers state lower prices cannot be quoted.

Quotations on chlorate of soda and benzol have declined slightly due to improvement in the condition of supply. Potash permanganate is about a cent lower, mainly due to keen competition on the part of sellers, and despite a very fair demand.

Animal, Vegetable and Fish Oils Show Some Changes

Animal, fish and vegetable oils have shown considerable fluctuation in price during the month, with some rather notable price variations on a few products.

Menhaden Fish Oil, from a price of 55 cents, is now quoted at as high as 66, due to fall catches of Menhaden fish having been unusually light. Stocks are the smallest on record for this season.

Sperm Oil, on the contrary registered a sharp decline around the first of November, buyers having apparently filled their needs, and has shown no improvement since, but it is quoted now at 99 to $1.04.

Linseed Oil is quoted two cents lower than thirty days ago, viz.: 86 to 87 in carloads, due to a generally dull market. Better prices are anticipated, as there is no reasonable explanation for this dullness and painting promises to be especially active both here and abroad this winter.

Herring, Soya Bean, Red and Lard oils have shown slight advances—Castor Oil a slight decline.

Naval Stores Decline

Turpentine has declined approximately 13 cents in the past month, with rosins showing a similar dullness. The situation with turpentine is quite similar to that of linseed oil—there is no satisfactory explanation of the market's dullness. Export demand has been slow, but foreign market authorities predict that painting activity will be above normal for the next three months. This, with the product's strong statistical position, promises maintained and perhaps stronger prices.

OIL JOBBERS SUPPLIES

Prices based on original packages in large quantities, f. o. b. manufacturing points—unless otherwise specified.

Animal, Fish and Vegetable Oils
(Quotations by Falk Company, Chicago)

	Prices	Dec. 1
Lard Oils—		
Prime, bbls., lb.		.15
Extra Winter Strained, bbls., lb.		13½
Extra, bbls., lb.		13
Extra No. 1, bbls., lb.		12½
No. 1, bbls., lb.		11¾
No. 2, bbls., lb.		11¼
Tallow, prime edible, lb.	9½	10
Tallow Oil, acidless bbls., lb.		11¾
Lard Stearine, bbls., lb.	.12¾	13
Oleo Stearine, bbls., lb.	10	10⅛
Neatsfoot Oil—		
Pure 20 cold test, bbls., lb.		.16½
Pure 30, cold test, bbls., lb		.14½
Extra, bbls., lb.		.12¼
No. 1, bbls., lb.		.11¼
Horse Oil, bbls., lb.	6½	6¾
Red Oil, distilled, bbls., lb.		10
English Degras, bbls., lb.	4½	5
Domestic Degras, bbls., lb.	4¾	5
Menhaden Fish Oil—		
Light Pressed bbls., gal.	62	66
Yellow Bleached, bbls., gal.	65	69
Herring Oil, tanks, coast, gal.	38	.40
Whale Oil, bleached, bbls., gal.		.75
Sperm Oil, bleached bbls., gal.	.99	1.04
Soya Bean Oil pressed, bbls., lb.		11½
Soya Bean Fatty Acids tanks, West, lb.	10¾	11
Tallow Fatty Acids, bbls., lb.	.07	.07½
Castor Oil—		
No. 1, bbls., lb.		12½
No. 3, bbls., lb.		12
Corn Oil—		
Middle West, tanks, lb.		.08
Cooperage, l. c. l.		09¾
Linseed Oil—		
Carloads, bbls., gal.	.86	.87
Less than 5 bbls., gal.		.92

NAVAL STORES

(Qutotations by National Rosin Oil & Size Company, Chicago)

Rosins—		
B to I, bbls (280 lbs.)	6.35	6.45
10-20 bbl. lots, f. o. b. shipping point		7.45
K to WW bbls. (280 lbs.)	6.50	8.00
10-20 bbl. lots, f. o. b. shipping point	7.60	9.10
Turpentine, spirits ex yard gal.		1.51
In drums		1.56
Rosin Oil, first run, gal.		.45
Rosin Oil, second run, gal		.47
Rosin, Pitch, bbl.		6.00
Tar, kiln burned		12.50
Tar, retort		11.00

REFINERS' SUPPLIES

Prices are based on original packages, in large quantities, and represent spot quotations, unless otherwise stated, f. o. b. manufacturing points.

(Quotations by Wishnick-Trumpeer Chem. Co., Chicago.)

Soda Ash, light bags, cwt.	1.75	2.10
Silicate of Soda, 60 deg., tanks, cwt		1.75
Sal Soda, cwt.	1.10	1.30
Caustic Soda, 76%, drums, cwt.	3.45	3.75
Chlorate of Soda, kegs, lb	.6½	.06¾
Nitrate of Soda, cwt.	2.52	2.55
Potash Permanagante, lb.	.15	.16
Potash Bichromate, sacks, lb.	.09¾	.10
Sulphuric Acid, 66 deg., tank cars, ton	.14	.16
Acetic Acid—		
28%, bbls., lb.	.03¼	.04
56%, bbls., lb.	.06¼	.07
80%, bbls., lb	.09¾	.10¼
Fullers Earth, 16-30 mesh, carloads, ton	23.00	25.00
Chloride of Lime, cwt.	2.00	2.25
Benzol, pure water white, gal.		.30
Benzol, 90%, gal.		.27
Toluol, gal.		.30

St. Louis—The St. Louis Southwestern Railroad (Cotton Belt Route) will use oil as fuel, according to a recent statement of Daniel Upthegrove, president of the system. The oil will be obtained from the Arkansas field which is tapped by the Cotton Belt.

Tulsa, Okla.—A new 165-horsepower gasoline compressor is being installed in the Henryetta district in Oklahoma by the Eagle-Pitcher Lead Company and the Black Petroleum Corporation. The compressor is being installed in a new field booster station in the field.

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We now believe that the industry's combined tank car output for 1923 will hardly exceed one-fifth of the trade's requirements—one car to every five wanted.

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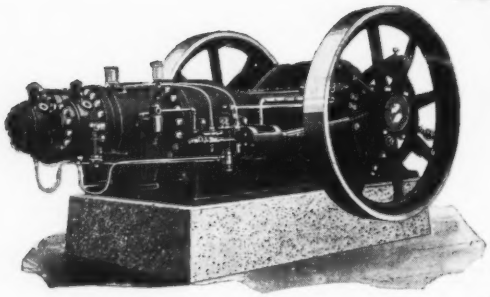

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